CONNECTICUT RIVER BASIN

SPRINGFIELD, NEW HAMPSHIRE

BOG BROOK DAM

NH 00194

NHWRB 220.16

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY

NEW ENGLAND DIVISION, CORPS OF ENGINEERS

WALTHAM, MASS. 02154

JULY 1980

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

DAMS, INSPECTION, DAM SAFETY,

Connecticut River Basin
Springfield, New Hampshire
Sugar River

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The dam is 817 ft. long and 18 ft. high. It is an earth embankment with a concrete drop inlet type principal spillway and an earth channel emergency spillway at the right abutment. It is small in size with a significant hazard potential. It is sn fair condition at the present time. No conditions were observed which warrent the attention of a registered engineer.

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254

REPLY TO
ATTENTION OF:

7 OCT 1980

NEDED

Honorable Hugh J. Gallen
Governor of the State of New Hampshire
State House
Concord, New Hampshire 03301

Dear Governor Gallen:

Inclosed is a copy of the Bog Brook Dam Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Water Resources Board, the cooperating agency for the State of New Hampshire. In addition, a copy of the report has also been furnished the owner, Palazzi Corporation, Hookset, New Hampshire 03106.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Water Resources Board for your cooperation in carrying out this program.

Sincerely,

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

NATIONAL DAM INSPECTION PROGRAM

PHASE I INSPECTION REPORT

Identification No.:	NH 00194
NHWRB No.:	220.16
Name of Dam:	Bog Brook Dam
Town:	Springfield
County and State:	Sullivan County, New Hampshire
Stream:	Bog Brook, A Tributary of the Stocker Brook which is a tributary of North Branch which is a tributary of the Sugar River
Date of Inspection:	May 6, 1980

BRIEF ASSESSMENT

The Bog Brook Dam is located on Bog Brook, approximately one half mile upstream of Stocker Pond in Springfield, New Hampshire. The dam is an 817 feet long and 18 feet high. It is an earth embankment with a concrete drop inlet type principal spillway and an earth channel emergency spillway at the right abutment.

The dam is owned by the Palazzi Corporation of Hooksett, New Hampshire. It was designed and constructed to serve as a siltation basin but is presently used only for recreational purposes.

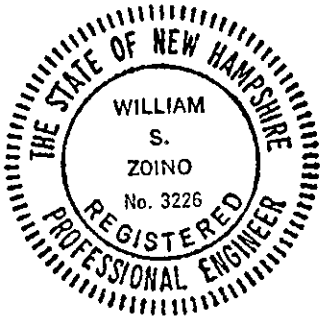
The drainage area of the dam covers 0.8 square miles and is made up primarily of rolling woodland with some minor development and pasture. The dam has a maximum impoundment of 210 acre feet. The dam is SMALL in size and its hazard classification is SIGNIFICANT since appreciable economic loss and the potential for loss of less than a few lives could result in the event of a dam failure.

Because of its small size and significant hazard, the required test flood for this dam would range from the 100-year frequency flood to one half of the PMF flood. A 100-year flood with an estimated peak inflow of 153 cfs was adopted. Because of storage, the resulting peak discharge is 120 cfs compared to a total spillway capacity of 580 cfs. The water surface would be at elevation 1041.5 feet (msl) or 2.5 feet below the top of the dam for this flood. The combined spillways are capable of passing 100 percent of the test flood.

The dam is in FAIR condition at the present time. Remedial measures to be undertaken by the owner include: implementing annual maintenance and inspection programs, monitoring the seepage at the right downstream toe, removing trees and brush from slopes and backfilling the holes left by the roots, regrading the upstream slope and placing rip rap or other form of slope protection, and developing a formal written system for warning downstream

officials in the event of an emergency. No conditions were observed which warrant the attention of a registered engineer.

The remedial measures outlined above should be implemented within one year of receipt of this report by the owner.



William S. Zoino
N.H. Registration No. 3226

Nicholas A. Campagna, Jr.
California Registration No. 21006

This Phase I Inspection Report on Bog Brook Dam **has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the** Recommended Guidelines for Safety Inspection of Dams, **and with good engineering judgment and practice, and is hereby submitted for approval.**

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

RICHARD DIBUONO, MEMBER
Water Control Branch
Engineering Division

ARAMAST MAHTESIAN, CHAIRMAN
Geotechnical Engineering Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation: however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

The Phase I Investigation does <u>not</u> include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

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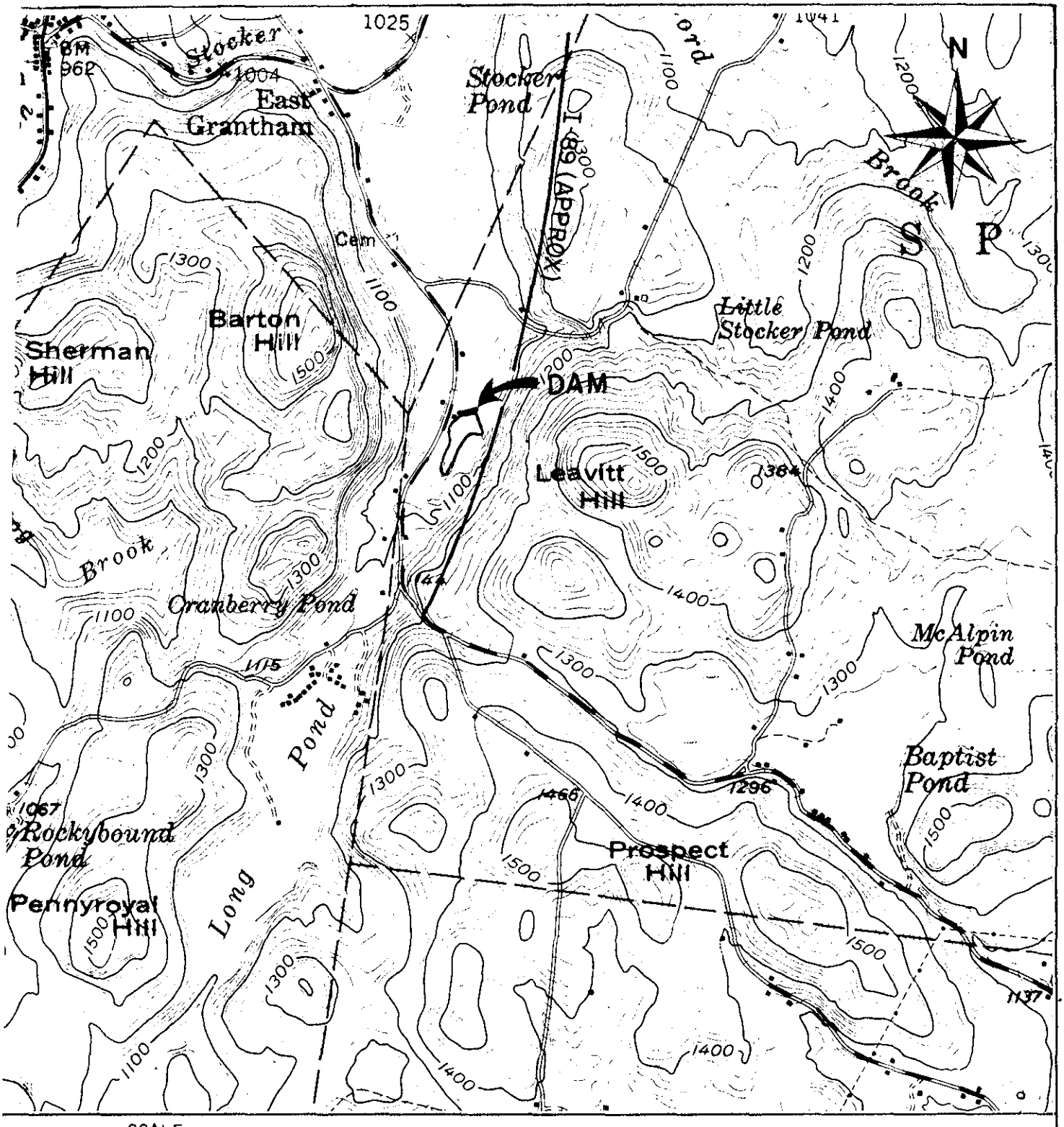
APPENDICES



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0 1/4 1/2 1 (MILE)

FROM: USGS SUNAPEE - N. H.
QUADRANGLE MAP

GOLDBERG · ZOINO & ASSOCIATES, INC. GEOTECHNICAL - GEOHYDROLOGICAL CONSULTANTS NEWTON UPPER FALLS, MASSACHUSETTS	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LOCATION MAP

FILE No. 2605

BOG BROOK DAM — SPRINGFIELD, N. H.

SCALE AS NOTED

DATE JULY 1980

Overview of Dam

National Dam Inspection Program

Phase I Inspection Report

Bog Brook Dam

Section I: Project Information

1.1 General

(a) Authority

Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Goldberg-Zoino & Associates, Inc. (GZA) has been retained by the New England Division to inspect and report on selected dams in the State of New Hampshire. Authorization and notice to proceed were issued to GZA under a letter of April 17, 1980 from Colonel William E. Hodgson, Jr., Corps of Engineers. Contract No. DACW 33-80-C-0055 has been assigned by the Corps of Engineers for this work.

(b) Purpose

1) Perform technical inspection and evaluation of non-federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-federal interests.

2) Encourage and prepare the states to initiate quickly effective dam safety programs for non-federal dams.

3) Update, verify, and complete the National Inventory of Dams.

1.2 Description of Dam

(a) Location

The Bog Brook Dam is located on Bog Brook approximately one half mile upstream of Stocker Pond in Springfield, New Hampshire. It can be reached from Stoney Brook Road which intersects State Route 10 in Grantham, New Hampshire. The dam is shown on U.S.G.S. Sunapee-New Hampshire Quadrangle at approximate coordinates N4328.2, W7206.5 (see location map on page vi). Page B-2 of Appendix B is a Site Plan for this dam.

(b) Description of Dam and Appurtenances

The dam consists of an earth embankment with an earth fill cutoff trench below the embankment, a principal spillway with a reinforced concrete riser and corrugated metal outlet pipe, and an emergency spillway located at the right abutment. The total length of the dam is 862 feet of which 45 feet is the emergency spillway.

1) Embankment (See page B-3)

The embankment is made up primarily of silty sand and gravel. It is 817 feet long with a 30 degree, horizontal bend approximately 175 feet from the left abutment. It is a maximum of 18 feet high, the crest width is 30 feet and the side slopes are 2 horizontal to 1 vertical.

According to available plans there is an earthfill cutoff trench which is 20 feet wide and approximately 2 feet deep and backfilled with the same material as the embankment.

2) Principal Spillway (see page B-3)

The principal spillway consists of a precast concrete block drop inlet manhole structure with a sealed pond drain inlet pipe and an uncontrolled orifice inlet. The outlet pipe is 30 inch diameter corrugated metal pipe with bituminous coating and it is approximately 83 feet long.

The riser structure is 10 feet high and 4 feet in inside diameter. The walls are 6 inches thick. At the bottom of the structure is a 12 inch diameter pond drain inlet pipe which extends 30 feet into the reservoir. The pond drain invert is at elevation 1029.0 feet (msl). The pond drain pipe is sealed at the upstream end.

The 4 foot diameter drop inlet opening is at elevation 1039.0. It is 5.0 feet below the crest of the dam. There is a conical trash rack of 1 inch diameter metal bars over the top of the inlet.

3) Emergency Spillway (see page B-3)

The emergency spillway was excavated in the right abutment. It is 25 feet wide at the control section and it curves left around the embankment. It is approximately 100 feet long and lies approximately 3.5 feet below the crest of the dam. The side slopes are 3 horizontal to 1 vertical. The control section is at elevation 1040.5

(c) Size Classification

The dam's maximum impoundment of 120 acre feet and height of 18 feet place it in the SMALL size category according to the Corps of Engineer's Recommended Guidelines.

(d) Hazard Potential Classification

The hazard potential classification for this dam is SIGNIFICANT because of the loss of a town road and damage to two houses and the small potential for loss of less than a few lives which could occur in the event of a dam failure. Section 5 of this report presents more detailed discussion of the hazard potential.

(e) Ownership

The dam is owned by the Palazzi Corporation, Box 717, Hookset, New Hampshire 03106. The owner can be reached by telephone at (603) 485-9575.

(f) Operator

The operation of the dam is controlled by the Owner, The Palazzi Corporation. Mr. David Hurst, the owner's representative, can be reached by telephone at (603) 485-9575.

(g) Purpose of the Dam

The dam was constructed as a siltation basin for a gravel operation. It now serves only recreational purposes.

(h) Design and Construction History

The dam was designed by the Palazzi Corporation. It was completed in 1968. Some hydraulic and hydrologic calculations were made by the USDA Soil Conservation Service in connection with this dam.

(i) Normal Operating Procedure

The dam is self regulating.

1.3 Pertinent Data

(a) Drainage Area

The drainage area for this dam covers 0.8 square miles. It is made up primarily of rolling woodland with some pasture and minor development.

(b) Discharge at Dam Site

1) Outlet Works

Normal discharge at the site is through the drop inlet structure, into the 30 inch diameter outlet pipe. In the event of severe flooding, water would flow over the emergency spillway. The drop inlet crest is at elevation 1039.0 feet (msl) and the emergency spillway is at elevation 1040.5 feet (msl).

2) Maximum Known Flood

There is no data available for the maximum known flood at this dam site.

3) Ungated Spillway Capacity at Top of Dam

The capacity of the principal spillway with the reservoir at top of dam elevation (1044.0 feet msl) is 70 cfs. The capacity of the emergency spillway is 510 cfs at this level.

4) Ungated Spillway Capacity at Test Flood

The capacity of the principal spillway with the reservoir at test flood elevation (1041.5 feet msl) is 70 cfs. The capacity of the emergency spillway is 50 cfs at this level.

5) Gated Spillway Capacity at Normal Pool

There are no gated spillways.

6) Gated Spillway Capacity at Test Flood

There are no gated spillways.

7) Total Spillway Capacity at Test Flood

The total spillway capacity at test flood elevation (1041.5 feet msl) is 120 cfs.

8) Total Project Discharge at Top of Dam

The total project discharge at top of dam elevation (1044.0 feet msl) is 580 cfs.

9) Total Project Discharge at Test Flood Elevation

The total project discharge at test flood elevation (1041.5 feet msl) is 120 cfs.

(c) Elevation (feet above msl)

1) Streambed at toe of dam: approximately 1026

2) Bottom of cutoff: Unknown

3) Maximum tailwater: Unknown

4) Recreation Pool: Approximately 1039.0

5) Full flood control pool: Not applicable

6) Spillway crest:

Principal Spillway: 1039.0
Emergency Spillway: 1040.5

7) Design surcharge: 1041.7

8) Top of dam: 1044.0

9) Test flood surcharge: 1041.5

(d) Reservoir (length in feet)

1) Normal pool: 800

2) Flood control pool: Not applicable

3) Spillway crest pool: 1200

4) Top of dam pool: 1600

5) Test flood pool: 1400

(e) Storage (acre-feet)

1) Normal pool: 40

2) Flood control pool: Not applicable

3) Spillway crest pool: 40

4) Top of dam pool: 120

5) Test flood pool: 80

(f) Reservoir Surface (acres)

1) Normal pool: approximately 12

2) Flood control pool: Not applicable

3) Spillway crest: approximately 16

4) Test flood pool: approximately 16

5) Top of dam: approximately 16

(g) Dam

1) Type: Earth embankment

2) Length: Approximately 817 feet

3) Height: Approximately 18 feet

4) Top width: Approximately 30 feet

5) Side slopes: Approximately 2 horizontal to 1 vertical

6) Zoning: Homogeneous, silty sand and gravel

7) Impervious core: Unknown

8) Cutoff: Earthfill, 20 feet wide, 2 feet deep

9) Grout curtain: Unknown

(h) Diversion and Regulating Tunnel

Not applicable

(i) Spillways

1) Type:

Principal Spillway: Precast concrete manhole drop inlet

Emergency Spillway: Grass and stone lined earth channel cut in the right abutment

2) Length of weir:
Principal Spillway: 48 inch diameter rim
Emergency Spillway: 25 feet

3) Crest elevation:
Principal Spillway: 1039.0
Emergency Spillway: 1040.5

4) Gates: None

5) Upstream channel: Reservoir

6) Downstream channel:
Winding sluggish stream across wide floodplain.

(j) Regulating Outlets

There are no regulating outlets on this dam. The pond drain consists of a pipe with a concrete plugged clay section which must be broken to allow water to exit the reservoir.

Section 2: Engineering Data

2.1 Design Data

Design data available for this dam includes hydraulic/hydrologic calculations by the Soil Conservation Service and a site plan drawing by the Palazzi Corporation. Significantly lacking are data on the foundation conditions.

2.2 Construction Records

No construction records are available for this dam.

2.3 Operational Records

No operational records are available for this dam.

2.4 Evaluation of Data

(a) Availability

The lack of detailed design and construction data warrants an unsatisfactory assessment for availability.

(b) Adequacy

The lack of in-depth engineering data does not permit a definitive review. Therefore, the adequacy of the dam cannot be assessed from the standpoint of reviewing design and construction data. This assessment of the dam is based primarily on the visual inspection, past performance and sound engineering judgement.

(c) Validity

Since the observations of the inspection team generally confirm the information contained in the records of the New Hampshire Water Resources Board, a satisfactory evaluation for validity is indicated.

Section 3: Visual Inspection

3.1 Findings

(a) General

The Bog Brook Dam is in FAIR condition at the present time.

(b) Dam

1) Main Dam Embankment (see photos 1,2,3,&4)

The upstream slope of the embankment has no rip rap or slope protection and has considerable erosion and sloughing over its length.(see photo 1) It appears that this slope was seeded but the sod has slumped from being undercut at the waterline. There are 5 to 10 erosion gullies on the upstream slope. The measured slope is 1.8 horizontal to 1 vertical.

The crest has tire ruts up to 3 inches deep along its entire length. The crest appears to be 1/2 to 3/4 of a foot higher at the left end than at the right end.

The downstream slope is 2 horizontal to 1 vertical. There is an irregularity approximately 180 feet left of the outlet pipe. This appears to be a local slough approximately 15 feet wide and 1 or 2 feet deep. From the outlet pipe to the right abutment is a wet area at the downstream toe which appears to be seepage although there are no signs of turbidity and no signs of moving flow. There is a deep erosion gully in this slope near the emergency spillway. There is much brush growth on the slopes and two small trees growing on the upstream slope to the left of the principal spillway. (see photos 1 & 4)

The emergency spillway is randomly lined with rock fill and is overgrown with brush and small trees. It is irregular in section and measures 25 feet wide at the highest point.

(c) Appurtenant Structures

The spillway structure appears to be in good condition. The trash rack is clear of debris. The rim of the inlet has three slots, measuring approximately 6 inches deep, cut into it. These show signs of erosion.

(d) Reservoir Area (see photo 4 and overview)

The shore of the reservoir is generally shallow sloping woodland or sandy beach. It appears stable and in good condition.

(e) Downstream Channel (see photo 6)

The outlet channel is a winding sluggish stream across a wide floodplain. It appears stable and in good condition.

3.2 Evaluation

The dam and its appurtenant structures are generally in fair condition. The problem areas noted during the visual inspection are listed as follows:

(a) Heavy brush and tree growth on slopes and emergency spillway channel.

(b) Signs of seepage at the downstream right toe.

(c) Lack of upstream slope protection.

(d) Irregular slope alignment, erosion gullies on slopes, and steep slopes.

Section 4: Operational and Maintenance Procedures

4.1 Operational Procedures

(a) General

No written operational procedures exist for this dam. The dam is normally self regulating.

(b) Description of any Warning System in Effect

There is no warning system in effect.

4.2 Maintenance Procedures

(a) General

No maintenance program exists for the dam. Maintenance is accomplished on an as-needed basis.

(b) Operating Facilities

No maintenance program exists and maintenance is performed infrequently.

4.3 Evaluation

Additional emphasis on routine maintenance will assist the Owner in assuring the long-term safety of the dam and operating facilities. A formal, written, downstream emergency warning system should be developed for this dam.

Section 5: Evaluation of Hydraulic/Hydrologic Features

5.1 General

Bog Brook Dam is located approximately 2 miles southeast of Granthem, New Hampshire. It is situated on Bog Brook about 3500 feet upstream of Stocker Pond.

The dam is an earth embankment 817 feet long and 18 feet high. The top of dam elevation is 1044.0 feet (msl). The principal spillway is a 4 foot diameter circular riser with a crest elevation of 1039.0 feet (msl). A pond drain leading to the riser is a 15 inch pipe with its invert at 1029 feet MSL. This drain is sealed, and can be opened by breaking a clay plug. The outlet pipe is a 30 inch diameter corrugated metal pipe. The pipe is 100 feet long with an invert elevation of 1028.0 feet (msl). The emergency spillway is a 25 foot wide, earth and rock lined channel with 3:1 side slopes. Its control section is at elevation 1040.5 feet (msl).

Downstream of the dam, Bog Brook is a winding, sluggish stream, with many pools and shallows and a wide floodplain. The first development downstream of the dam is a group of three houses 7-10 feet above the stream some 1000 feet from the dam. A small dirt road embankment with two 60 inch culverts crosses Bog Brook 1500 feet further downstream.

Bog Brook Dam would pass the adopted test flood (100 year flood) through the principal and emergency spillways with the water surface 2.5 feet below the top of the dam.

5.2 Design Data

Data sources available for Bog Brook Dam include summaries of design calculations by the Soil Conservation Service dated October 22, 1968. Also available are design drawings dated 1968 by the Palazzi Corporation and correspondence between the Palazzi Corporation and the New Hampshire Water Resources Board regarding construction of the dam.

5.3 Experience Data

No records of flow or stage are known to be available for Bog Brook Dam or the area immediately downstream.

5.4 Test Flood Analysis

The Hydrologic conditions of interest in this Phase I investigation are those required to assess the dam's overtopping potential and its ability to safely allow an appropriately large flood to pass. This requires use of the discharge and storage characteristics of the structure to evaluate the impact of an appropriately sized Test Flood. Some original hydraulic and hydrologic design analysis by the Soil Conservation Service was available for this dam.

Guidelines for establishing a recommended Test Flood based on the size and hazard classification of a dam are specified in the "Recommended Guidelines" of the Corps of Engineers. The impoundment of less than 1000 acre-feet and the height of less than 40 feet classify this dam as a SMALL structure.

The appropriate hazard classification for this dam is SIGNIFICANT because of the appreciable economic losses and small potential for loss of life downstream in the event of failure of the dam. As shown in the Dam Failure Analysis section, the increase in flooding caused by failure would cause property damage to two of the three houses 1000 feet downstream of the dam.

As shown in Table 3 of the "Recommended Guidelines," the appropriate Test Flood for a dam classified as SMALL in size with a SIGNIFICANT hazard potential would be between the 100-year flood and one-half the probable maximum flood (PMF). Since the risk downstream in the event of dam failure is on the low side of SIGNIFICANT, the 100-year flood is the appropriate Test Flood.

The SCS calculations show a peak 100-year inflow of 153 cfs for the dam. This is 196 CSM for the 500 acre drainage area. Attenuation due to storage in the reservoir results in a Test Flood routed peak outflow of 120 cfs, with the reservoir water surface at 1041.5 feet MSL. This is 2.5 feet above the principal spillway crest, 1.0 feet above the emergency spillway crest, and 2.5 feet below the dam crest. The peak Test Flood outflow of 120 cfs is only 20.7% of the total discharge capacity of 580 cfs with the water surface at the dam crest.

5.5 Dam Failure Analysis

The peak downstream flows that would result from the failure of Bog Brook Dam are estimated using the procedure suggested in "Rule of Thumb Guidelines for Estimating Downstream Dam Failure Hydrographs." The failure is assumed to occur with the water surface elevation at the dam crest, 1044 feet MSL. The outflow prior to dam failure would be 580 cfs, creating a tailwater of about 3.3 feet in the channel downstream of the dam.

For an assumed breach width equal to 40 percent of the dam width at the half-height, the gap in the embankment due to failure would be about 250 feet. The resulting peak failure outflow would be 24,300 cfs given the 18 foot embankment height and 3.3 foot tailwater.

The peak flow resulting from dam failure would be attenuated to 11,100 cfs at the 3 houses 1000 feet downstream of the dam, resulting in a peak stage of 8.3 feet. This would cause 1-2 feet of flooding at one house and 0-1 feet at another. This would cause damage to the houses but would present only a small threat of loss of life.

About 1500 feet downstream of the three houses there is a small dirt road crossing Bog Brook with two-60 inch culverts. This embankment would probably be damaged or destroyed by dam failure flows.

Downstream of this road, Bog Brook flows about 1000 feet further to Stocker Pond. The large floodplain in this reach would continue rapid attenuation of the failure flood wave from the Bog Brook Dam. The dam failure flow would probably not cause damage to any property near Stocker Pond, and this large pond would further attenuate failure flows, rendering downstream effects negligible.

The table on the next page summarizes the downstream effects of the failure of Bog Brook Dam.

Location No. (see Map)	Distance Downstream of Dam (ft.)	# of Structures	Level above Stream (ft.)	Flow & Stage Before Failure	Flow & Stage After Failure	Comments
-	500	-	-	580 cfs 3.3 ft.	15,500 cfs. 9,1 ft.	
1	1000	1 house 1 house 1 trailer	10 8 7	580 cfs 3.3 ft.	11,100 cfs 8.3 ft.	Some damage to house & trailer. Little danger of loss of life
2	2500	road	~7	-	-	probably washed out
Stocker Pond	500	-	-	-	-	negligible damage; pond attenuates flow

Section 6: Structural Stability

6.1 Visual Observations

There does not appear to be significant displacement or distress. The side slopes are significantly steeper than those indicated on the typical cross section prepared by the Palazzi Corporation (see page B-3).

6.2 Design and Construction Data

No records of structural stability analyses are available for this dam.

6.3 Post Construction Changes

There have been no known changes to any of the embankments or structures.

6.4 Seismic Stability

The dam is located in seismic zone No. 2 and, in accordance with the recommended Phase I guidelines, does not warrant seismic analysis.

Section 7: Assessment, Recommendations and Remedial Measures

7.1 Dam Assessment

(a) Condition

The dam embankment is in fair condition at the present time. The riser structure and outlet conduit are in good condition.

(b) Adequacy of Information

The lack of in-depth engineering data does not permit a definitive review. Therefore, the adequacy of the dam cannot be assessed from the standpoint of reviewing design and construction data. This assessment is based primarily on the visual inspection, past performance, and sound engineering judgement.

(c) Urgency

The engineering studies and improvements described herein should be implemented by the owner within one year of receipt of this Phase I Inspection Report.

7.2 Recommendations

It is recommended that the services of a qualified registered professional engineer be retained to investigate the condition of the upstream slope and make recommendations for the regrading of the slope and the placement of slope protection such as riprap. The owner should implement the findings of the engineering study.

7.3 Remedial Measures

It is recommended that the owner institute the following remedial measures:

1) Implement and intensify a program of diligent and periodic maintenance including, but not limited to: mowing brush on slopes; backfilling animal burrows or tire ruts with suitable well tamped material; cleaning debris from spillways and slopes.

2) Remove trees and saplings from slopes including the roots. Resulting voids should be backfilled with suitable compacted material.

3) Regrade and fill in the erosion gullies on the downstream slope. Reseed the disturbed areas.

4) Develop and implement a workable plan for lowering the reservoir level in an emergency situation.

5) Monitor the seepage in wet areas at the downstream toe.

6) Develop a written downstream flood warning system to alert the appropriate officials in the event of an emergency.

7) Develop and implement a program or annual technical inspections.

7.4 Alternatives

There are no meaningful alternatives to the above recommendations.

APPENDIX A

VISUAL INSPECTION CHECKLIST

Inspection Team Organization

DATE: May 6, 1980

PROJECT: NH 00194
Bog Brook Dam
Springfield, New Hampshire
NHWRB No. 220.16

WEATHER: Clear, warm

Inspection Team

Nicholas A. Campagna	Goldberg Zoino & Associates, Inc.	Team Captain
William S. Zoino	Goldberg Zoino & Associates, Inc.	Soils
Jeffrey M. Hardin	Goldberg Zoino & Associates, Inc.	Soils
Andrew Christo	Andrew Christo Engineers	Structures
Paul Razgha	Andrew Christo Engineers	Structures
Carl Razgha	Andrew Christo Engineers	Structures

Owners representantives present:
Mr. David Hurst and Mr Charles Gilmore of the Palazzi Corporation

Robert Fitzgerald and Richard Laramie of Resource Analysis Inc. performed the hydrologic inspection of this dam on April 24, 1980.

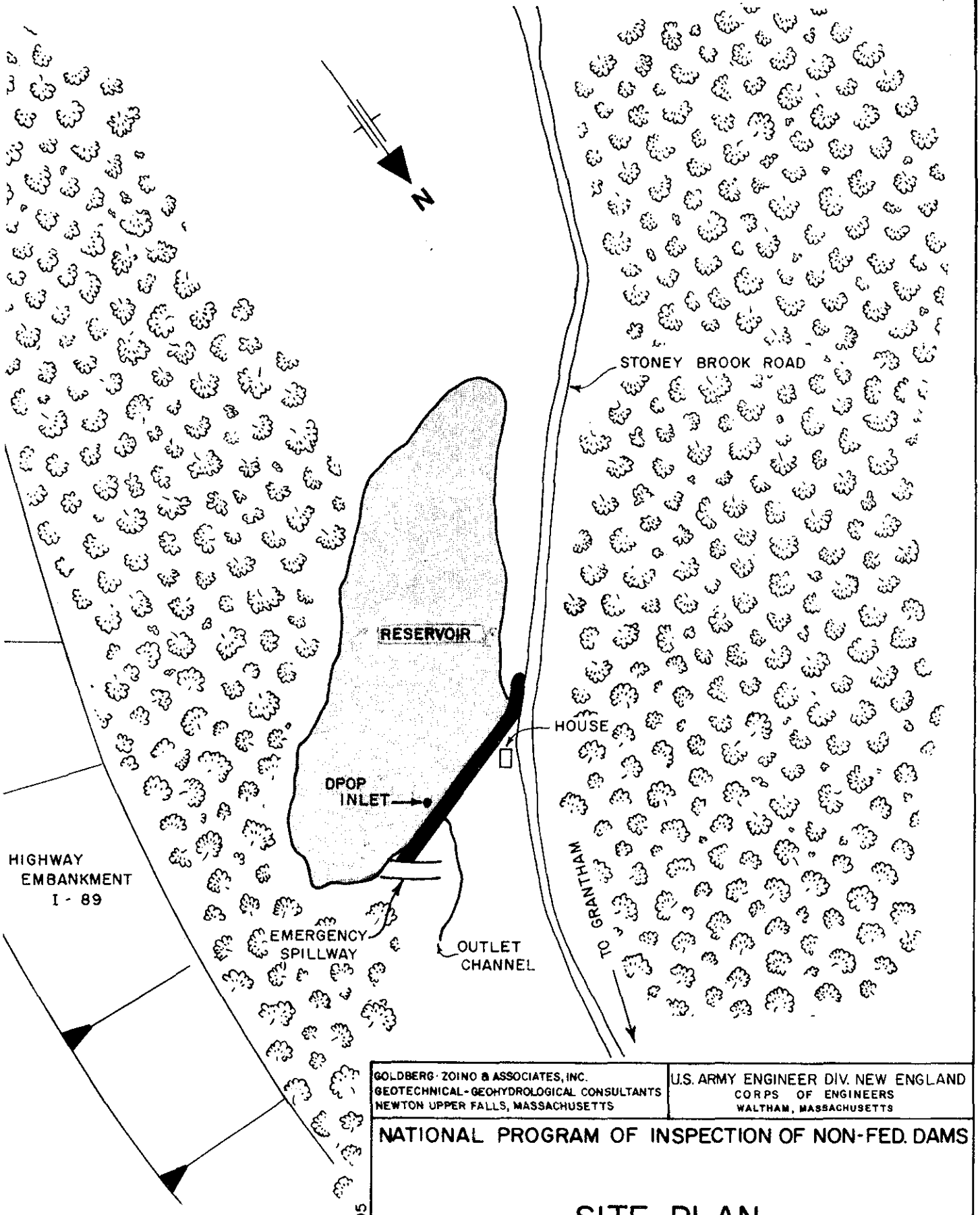
CHECKLISTS FOR VISUAL INSPECTION

AREA EVALUATED	BY	CONDITION & REMARKS
DAM EMBANKMENT		
Crest Elevation	NAC	Variable
Current Pool Elevation		Approximately 1039.8 ft.
Maximum Impoundment to Date		Unknown
Surface Cracks		None noted
Pavement Condition		Not Applicable
Movement or Settlement of Crest		None noted
Lateral Movement		None noted
Vertical Alignment		Irregular
Horizontal Alignment		Good
Condition at Abutment and at Concrete Structures		Good
Indications of Movement of Structural Items on Slopes		None
Trespassing on Slopes Vegitation on Slopes		Brush and small trees growing on both up and downstream slopes.
Sloughing or Erosion of Slopes or Abutments		Upstream slope unprotected. Evidence of undercutting due to wave action, erosion gullies in downstream slope.
Rock Slope Protection -- Riprap Failures		None
Unusual Movement or Cracking at or Near Toes		None noted
Unusual Embankment or Downstream	NAC	Area downstream right of dam

CHECKLISTS FOR VISUAL INSPECTION

AREA EVALUATED	BY	CONDITION & REMARKS
Seepage	NAC	has ponded water. Appears to be seepage. No visible flow.
Piping or Boils		None noted
Foundation Drainage Features		None noted
Toe Drains		None noted
Instrumentation System	NAC	None noted
Drop Inlet Spillway Structure		
Condition of Concrete	PR	Good
Spalling		None noted
Erosion		None noted
Cracking		None noted
Rusting or Staining of Concrete		None noted
Visible Reinforcing		None noted
Efflorescence		None noted
Trash Racks		No deficiencies noted
Reservoir Discharge Conduit		Submerged, could not be inspected
Outlet Conduit	PR	No deficiencies noted

APPENDIX B



GOLDBERG · ZOINO & ASSOCIATES, INC.
GEOTECHNICAL - GEOHYDROLOGICAL CONSULTANTS
NEWTON UPPER FALLS, MASSACHUSETTS

U.S. ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

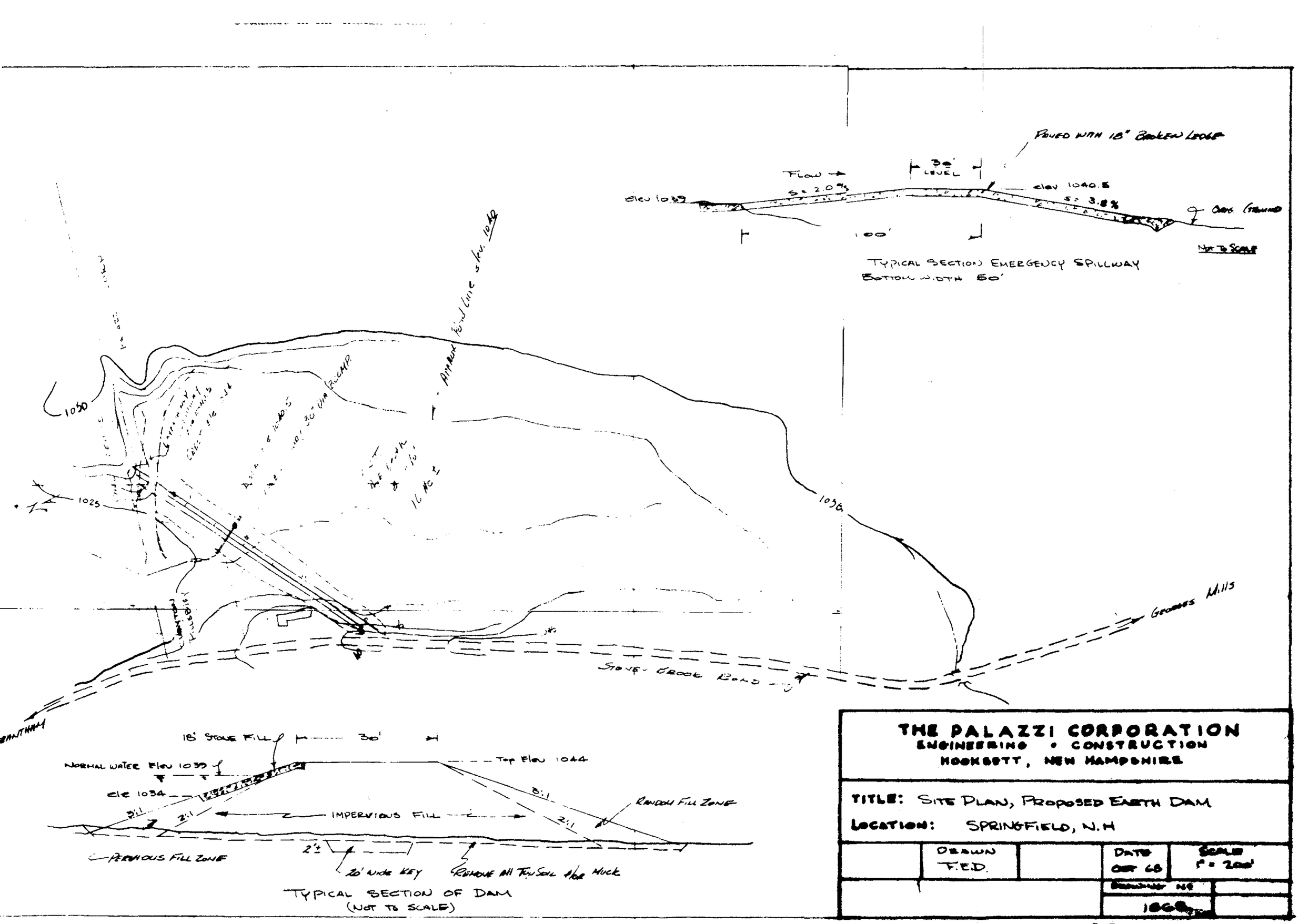
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

SITE PLAN

BOG BROOK DAM — SPRINGFIELD, NEW HAMPSHIRE

FILE No. 2605

SCALE 1" = 400' (APPROXIMATE)
DATE JUNE 1980



Typical Section Emergency Spillway
Bottom Width 50'

TYPICAL SECTION OF DAM
(NOT TO SCALE)

THE PALAZZI CORPORATION
ENGINEERING • CONSTRUCTION
HOOKSETT, NEW HAMPSHIRE

TITLE: SITE PLAN, PROPOSED EARTH DAM
LOCATION: SPRINGFIELD, N.H

	DRAWN F.E.D.		DATE OCT 68	SCALE 1" = 200'
			DRAWING NO	
			1068	

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO 1958 O—470048

STATE		PROJECT		
N.H.		PALAZZI CORP. DAM, SPRINGFIELD, N.H.		
BY	DATE	CHECKED BY	DATE	JOB NO.
B.F.B.	10-22-68			

SUBJECT: SUMMARY OF HYDROLOGIC DATA & SPILLWAY INFO. SHEET 1 OF 5

LOCATION OF PROPOSED DAM

SPRINGFIELD, N.H.
LATITUDE N 43°-28'-10"
LONGITUDE 72°-06'-30"
2.1" DOWN & 5.5" LEFT OF UPPER RIGHT CORNER OF SUNAPEE, N.H., U.S.G.S. TOPOGRAPHIC MAP.

HYDROLOGIC DATA

DRAINAGE AREA = 500 AC. = 0.78 MI.²

S.C.C # (SOIL COVER COMPLEX NO.) = 65 (A.M.C. II)

T_C (TIME OF CONCENTRATION) = 1.34 HRS

SITE DATA (FROM F. DREW)

TOP WIDTH OF DAM = 30' S:S = 3:1
ELEV. OF TOP OF DAM = 1043
MAX. HEIGHT OF DAM ≈ 18'
SURFACE AREA OF PERMANENT POOL ≈ 8 AC.

PIPE SPILLWAY

CRITERIA: RUNOFF FROM 25 YEAR 6 HR. RAINFALL BE PASSED & STORED AT OR BELOW THE CREST OF EMERGENCY SPILLWAY. (A.M.C. II)

RAINFALL $P_{25YR\ 6HR}$ = 3.35"
PEAK INFLOW $Q_{25YR\ 6HR}$ = 96.5 C.F.S.
DEPTH OF RUNOFF FROM D.A. = 0.68"
VOLUME OF RUNOFF = 28.3 AC. FT.

STATE	PROJECT			
N.H.	PALAZZI CORP. DAM, SPRINGFIELD, N.H.			
BY	DATE	CHECKED BY	DATE	JOB NO.
B.P.B.	10-22-68			

SUBJECT SUMMARY - PIPE SPILLWAY (CONT'D.) SHEET 2 OF 5

APPROXIMATE PROFILE, SIZE & ELEVS. OF PIPE SPILLWAY (SEE SHEET 3)

CREST OF RISER ELEV. 1039

" " EMER. SPILL. 1040.5

Q_p (PIPE SPILLWAY CAPACITY W/W.S. @ 1040.5) = 63 c.f.s.

REQUIRED Q_p = 56 c.f.s. (BY SHORT CUT ROUTING)

EMERGENCY SPILLWAY

CRITERIA: Q_p + EMER. SPILL. CAP. (Q_{es}) =

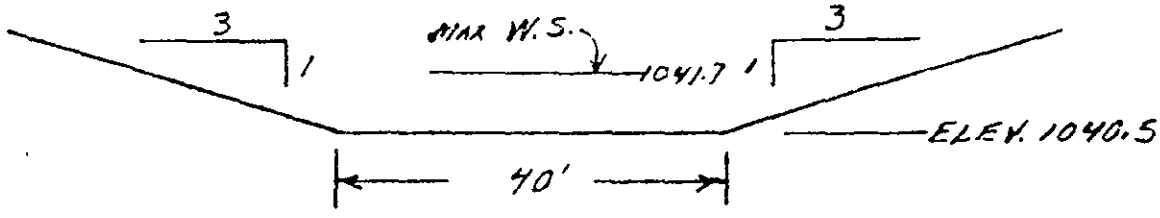
ESH { PEAK RUNOFF FROM EMERGENCY SPILLWAY HYDROGRAPH (Q_{ES}), 100 YR. 6 HR. RAINFALL AMC II $P_{100yr\,6hr}$ = 4.25" RUNOFF = 1.18" (NO ROUTING)

Q_{ES} = 153 c.f.s.

$Q_{es} = Q_{ES} - Q_p = 153 - 63 =$ 90 c.f.s.

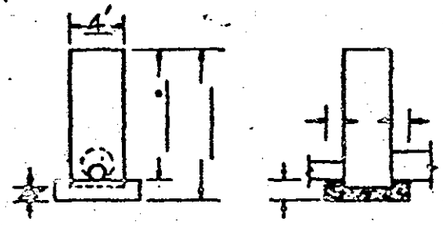
MAX. WATER SURFACE ELEV. FOR ESH = 1041.7

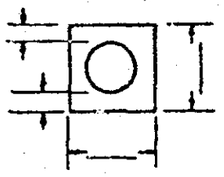
X-SECT. OF SPILLWAY



VOLUME OF CONCRETE	
ITEM	CU.YDS.
RISER FOUNDATION	
OTHER	
TOTAL	

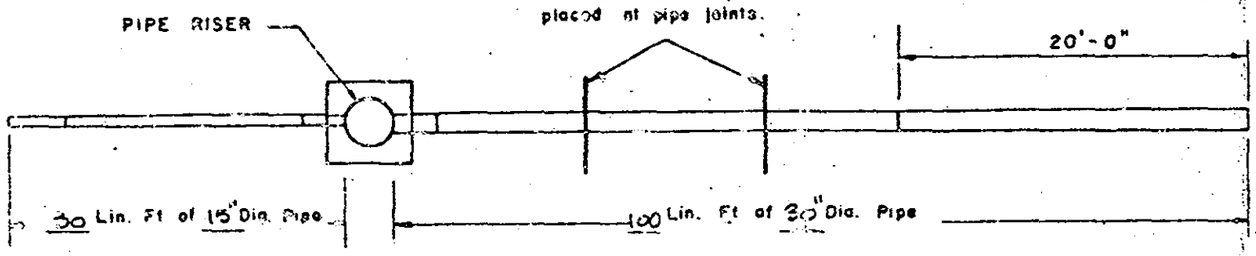
PIPE RISER, PRECAST CASE.

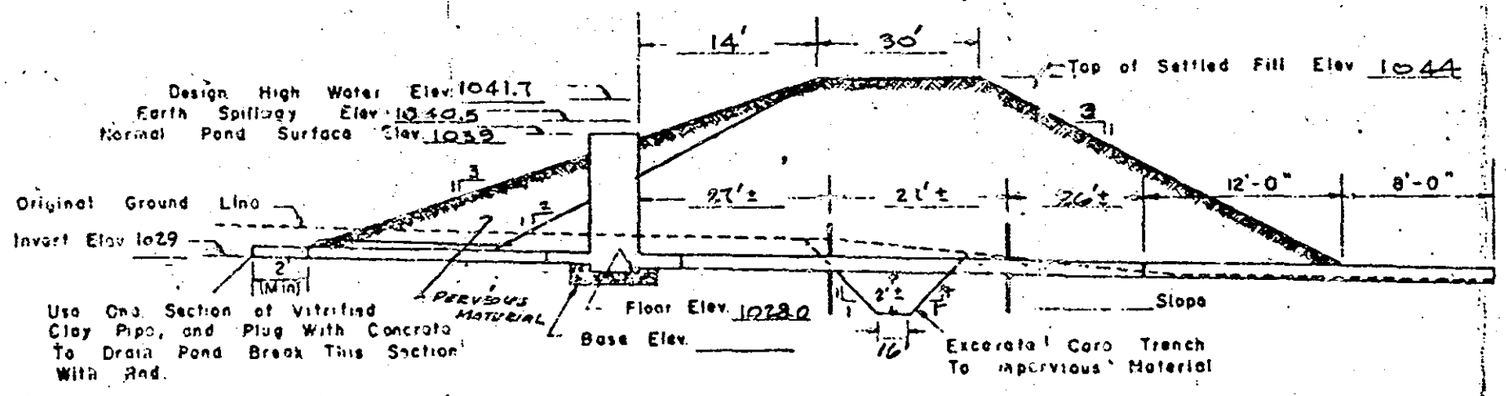




NOTE:
Use watertight coupling bands at pipe joints.

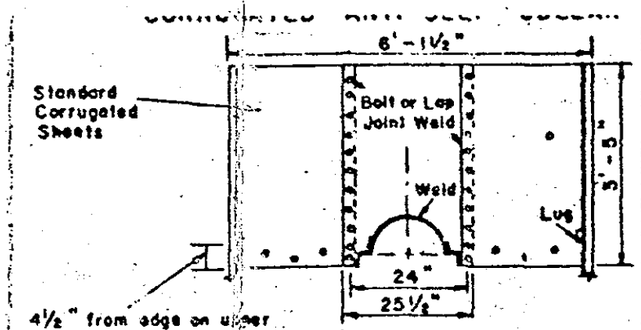
Anti-Seep Collars, not to be placed at pipe joints.

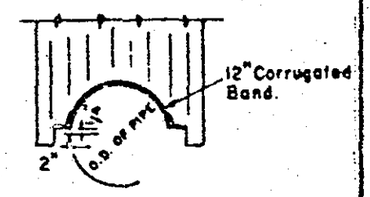


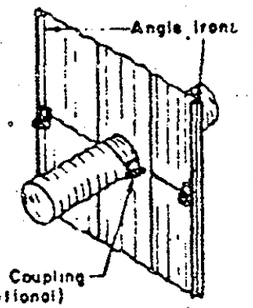


SECTION ON CENTERLINE OF PIPE

CORRUGATED METAL PIPE RISER



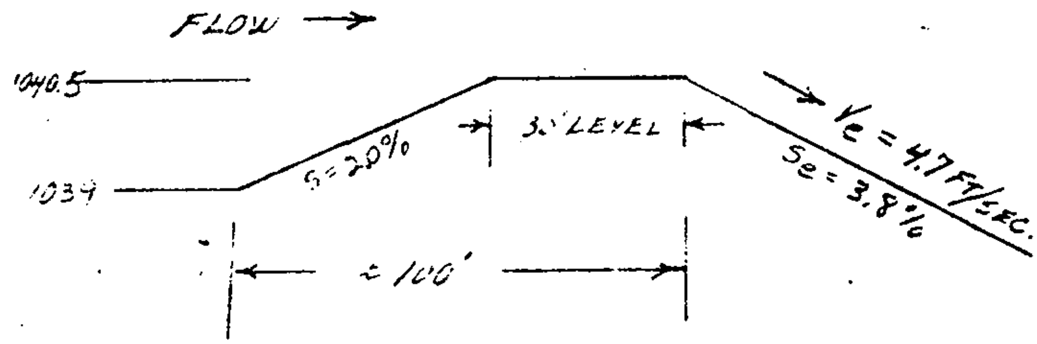




NOTES:
Holes "match-punched" in shop to permit field bolting.
Galvanized bolts to be furnished with collar.
Lap between two sections to receive extra bituminous coating at time of assembly.
Collar to be fully bituminous coated.

STATE: N.H	PROJECT: PALAZZI CORP. DAM SPRINGFIELD, N.H.			
BY: R.P.B	DATE: 12-23-68	CHECKED BY:	DATE:	JOB NO.:
SUBJECT: SUMMARY - EMER. SPILL. (CONT'D.)				SHEET 4 OF 5

ASSUMED PROFILE OF EMER. SPILL.



FREEBOARD & TOP OF DAM ELEV.

TOP OF DAM ELEV. = 1043 (GIVEN)

CRITERIA: TOP OF DAM ≥ MAX WATER SURFACE REQUIRED TO PASS THE PEAK INFLOW FROM THE FREEBOARD HYDROGRAPH THRU THE PIPE & EMERGENCY SPILLWAYS.

P_{FBH} 6 HR = 6.3"

Q_{FBH} = 468 c.f.s.

$Q_{ES\,FBH} = Q_{FBH} - Q_P$ Q_P = 68 c.f.s. W/W.S. @ 1043

$Q_{ES\,FBH}$ = 468 − 68 = 400 c.f.s.

COMPUTATION SHEET

SCS-522 REV 5-58

SOIL CONSERVATION SERVICE

GPO 1958 O—470666

STATE N.H | PROJECT PANAZZI CORP SPRINGFIELD N.H

BY B.P.B. | DATE 10-23-67 | CHECKED BY | DATE | JOB NO.

SUBJECT SUMMARY SPILLWAY CAPACITIES | SHEET 5 OF 5

WATER SURFACE ELEV.	PIPE SPILLWAY CAP. C.F.S.	EMERGENCY SPILLWAY CAP. C.F.S.
1040.5 (CREST OF EMER. SPILL.)	63	—
1041.7 (MAX. ELEV. OF E.S.H.)	65	90 (@ 4.7 FT/SEC)
1043 (TOP OF DAM)	68	400 (@ 6.9 FT./SEC)

November 20, 1968

The Palazzi Corporation
Box 717
Hooksett, New Hampshire

Attention: Frederick E. Drew, Jr.

Dear Sirs:-

At a session of the New Hampshire Water Resources Board held at its offices in Concord, New Hampshire, on November 7, 1968;

WHEREAS, The Palazzi Corporation has filed with this Board on November 4, 1968 a "Statement of Intent" to construct a dam in Springfield, New Hampshire; and

WHEREAS, the Board has considered said Intent and finds that if constructed in accordance with plans and if properly maintained, it will not be a menace to public safety;

IT IS ORDERED, that the "Statement of Intent" of said Palazzi Corporation be and is granted with the understanding that the work shall be performed in accordance with plans and that the dam shall be properly maintained at all times.

By order of the New Hampshire Water Resources Board this twentieth day of November, nineteen hundred and sixty eight.

Very truly yours,

George M. McGee, Sr.
George M. McGee, Sr.
Chairman

GMM/RWL/jb

THE STATE OF NEW HAMPSHIRE

County of Sullivan ss. October 31, 1968

STATEMENT OF INTENT TO CONSTRUCT OR

RECONSTRUCT A DAM AT Springfield

TO THE WATER RESOURCES BOARD:

In compliance with the provisions of RSA 482:3.

We,
I, THE PALAZZI CORPORATION
(Here state name of person or persons, partnership, association, corporation,

Box 717, Hooksett, New Hampshire 03106
etc.)

hereby state our intent to the Water Resources Board to construct, ~~reconstruct, repair~~ a dam along, or (cross out portion not applicable) across:

No name, (outlet of Cranberry Pond)
(Here state name of stream or body of water)

At a point about 0.30 mile S.E. of Springfield
(Here give location, by distance from mouth of stream, county or
LAT N 43° - 28' - 10"
Grantham Town Line, LONG W 72° - 06' - 30"
municipal boundary)

in the town (s) of Springfield

in accordance with PRELIMINARY PLANS, and SPECIFICATIONS FILED WITH THIS STATEMENT AND MADE A PART HEREOF.

We, I, understand that more detailed plans and specifications may be requested by the Board in conformance with RSA 482:4 and that, if such plans are requested, construction will not commence until such plans have been filed with and approved by the Board.

The purpose of the proposed construction is initially
(Here briefly state use to

to provide a desilting basin
which stored water is to be put)

upstream of Stocker Pond, later use as recreation pond anticipated

The construction will consist of earth dam, 18' high
(Here give brief description of

with emergency spillway, (basic design was by Soil Conservation
work contemplated including height of dam)

Service)

All land to be flowed ~~is not~~ is owned by applicant.

THE PALAZZI CORPORATION

Frederick E. Nims Jr.
V.P. Const

Address P.O. Box 717

Hooksett, N.H. 03106

Note: This statement together with plans, specifications and information and data filed in connection herewith will remain on file in the office of the Water Resources Board. This statement is to be filed in duplicate.

STATE OF NEW HAMPSHIRE

INTER-DEPARTMENT COMMUNICATION

DATE November 6, 1968

FROM Robert W. Livingston
Civil Engineer

AT (OFFICE) Water Resources Board

SUBJECT Statement of Intent
The Palazzi Corporation

TO Allen I. Lewis, Chief
Maintenance, Construction and
Engineering Division
Fish and Game Department
34 Bridge Street
Concord, New Hampshire

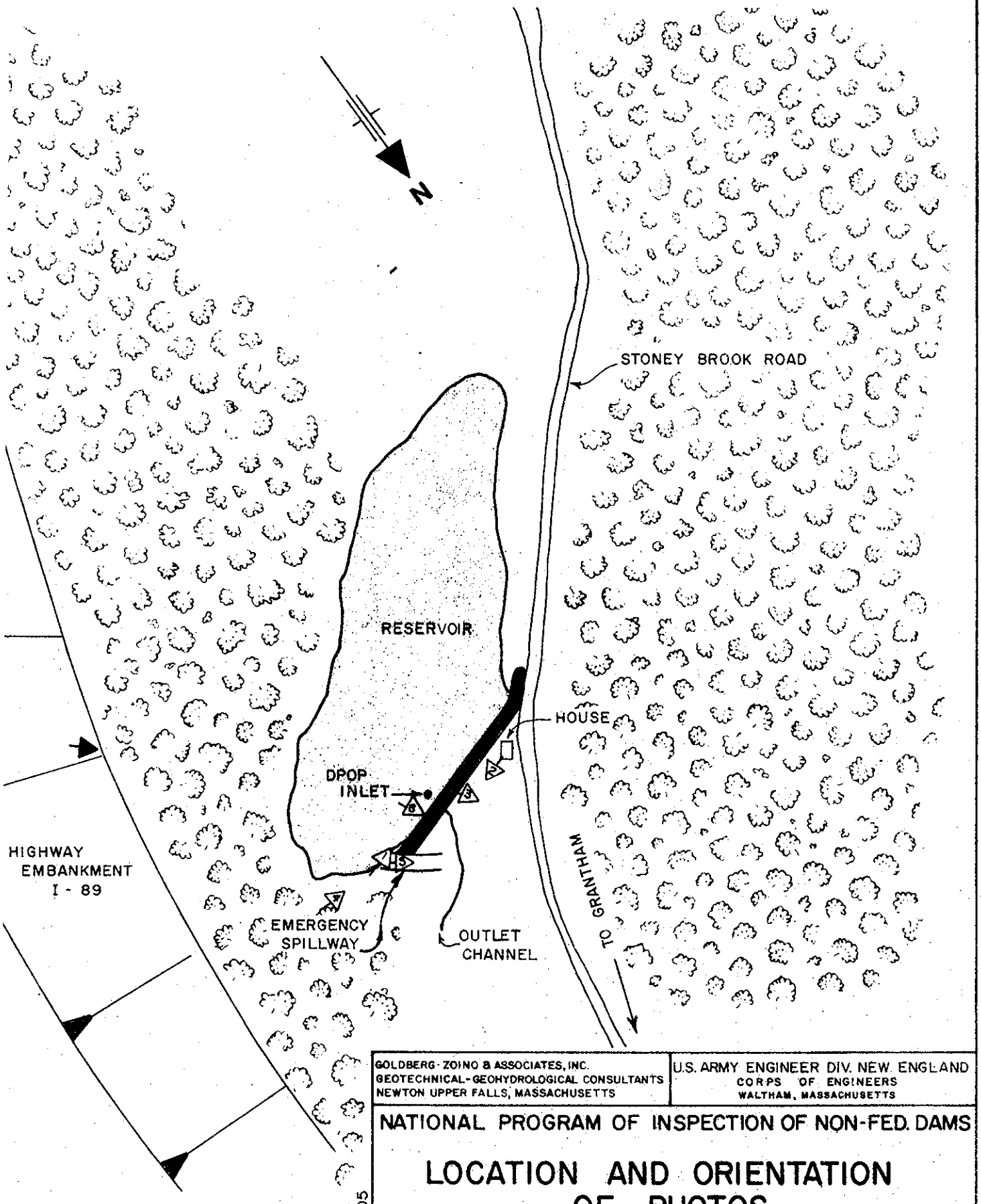
For your consideration and comments we enclose Statement of Intent in connection with the captioned firm and Springfield project.

RWL/jb

Enc.

APPENDIX C

PHOTOGRAPHS



GOLDBERG-ZOINO & ASSOCIATES, INC.
GEOTECHNICAL-GEOHYDROLOGICAL CONSULTANTS
NEWTON UPPER FALLS, MASSACHUSETTS

U.S. ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LOCATION AND ORIENTATION OF PHOTOS

FILE No.2605

BOG BROOK DAM — SPRINGFIELD, NEW HAMPSHIRE

SCALE 1" = 400' (APPROXIMATE)

DATE JUNE 1980

1. View of Upstream Slope Showing Sloughing and Brush Growth

2. View of Downstream Slope Showing Wet Area at Right Toe

3. View of Large Erosion Gully on Downstream Slope

4. View from Right Abutment Showing Emergency Spillway Channel

5. View of Emergency Spillway Channel Looking Downstream

6. View of Outlet Channel Looking Downstream

7. Principal Spillway Inlet

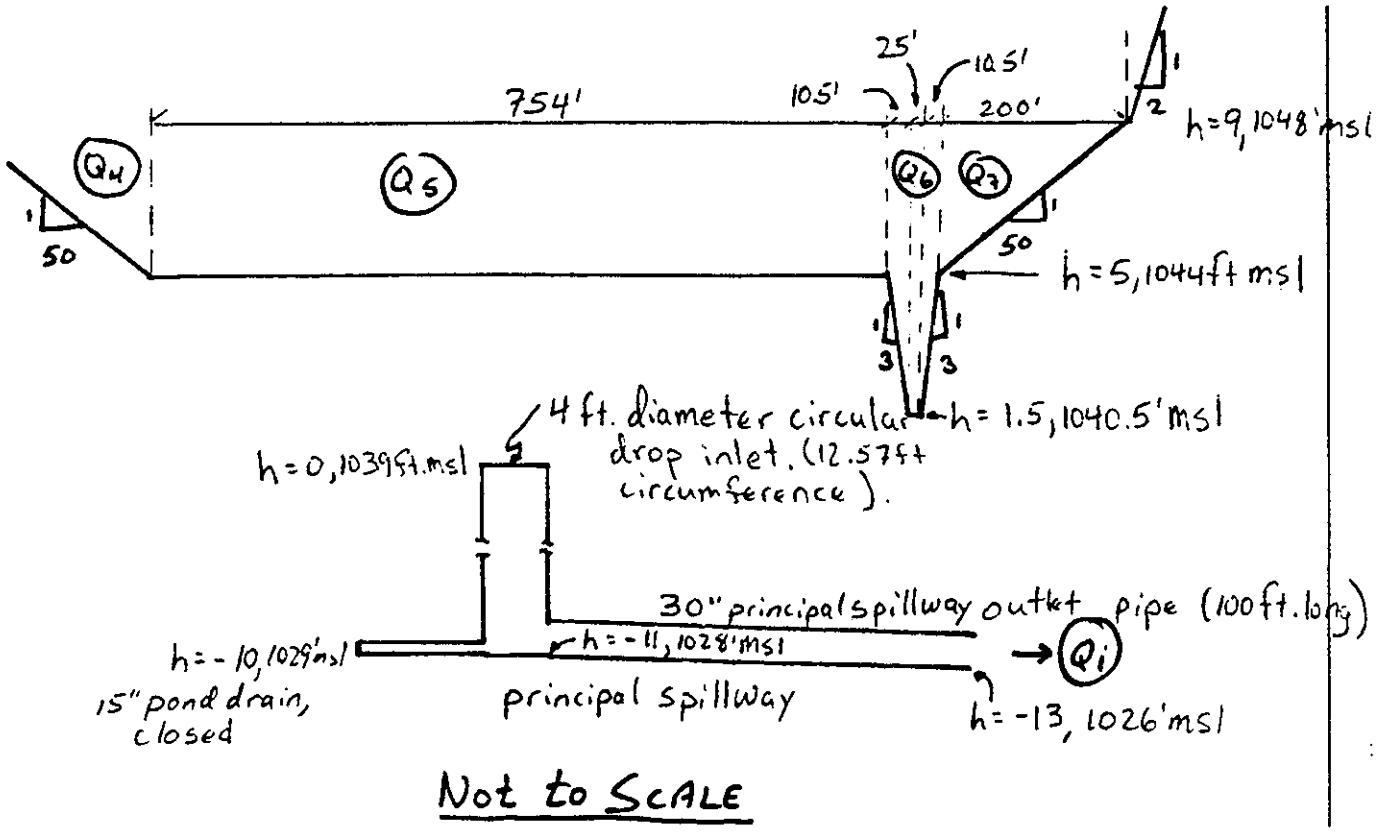
APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

BOG BROOK DAM

TCG
5/16/80

The elevation of Bog Brook Dam given below is based on field notes, dam plans, and USGS topo information.



Not to Scale

Stage-Discharge Curve

Principal Spillway

The principal spillway is a four foot diameter circular riser with a circumference of 4π = 12.57 ft. and a crest elevation of 1039 ft. msl (h = 0). The outlet from the riser is a 30" RCP with a 2 foot drop in 100 ft. There is a second inlet to the riser - a 15" pond drain with an invert at 1029 ft. msl (h = -10). The pond drain will be assumed to be closed for these calculations.

Q_2 = weir flow = $3.3(12.57)(h)^{3/2}$ C = 3.3 for sharp-crested weir.

Q_3 = pipe flow = $C\ (h+13)^{1/2}$

from page 5 of the SCS calculations,

C = 16.5

so $Q_3 = 16.5\ (h+13)^{1/2}$

Q_1 = principal spillway outflow = minimum of Q_2 and Q_3.

Emergency Spillway

SCS Technical Release #39, "Hydraulics of Broad Crested Spillways" allows computation of Q vs. H_{pool} for the emergency spillway. Figure ES-171 relates H_{pool} to H_{ec}, the head at the weir crest for a given spillway shape and L. Figure ES-175 relates H_{ec} to Q.

z = side slopes = 3:1

b = width = 25 ft.

l = length of flow path = 105 ft.

H_{pool} = head above spillway crest in pool, ft.

H_{ec} = head at spillway control section, ft.

Q = outflow, cfs

BOG BROOK DAM

TCG
5/19/80

(ft.)	Elevation (ft. msl)	H_{pool} (ft. above En. S/W crest)	H_{ec}* (ft)	Q** (cfs)
0.0	1039	-	-	-
1.5	1040.5	0	0	0
2.0	1041	.5	~.19	~10
2.2	1041.2	.7	.465	25.2
2.5	1041.5	1	.72	49.9
3.0	1042	1.5	1.17	105
3.5	1042.5	2	1.62	180
4.0	1043	2.5	2.09	272
4.5	1043.5	3	2.57	383
5.0	1044	3.5	3.03	510
5.5	1044.5	4	3.51	660
6.0	1045	4.5	4.00	880
6.5	1045.5	5	4.49	1010

*Figure ES-171, Sheet 2 in TR-39.

**Figure ES-175, Sheets 2 and 5 in TR-39.

BOG BROOK DAM

TCG
5/19/80

Top of Dam

For $h \geq 5$

$$Q_4 = Q_5 = Q_7 = Q_8 = 0$$

For $5 \leq h \leq 9$

$$Q_4 = 2.8 \ (50) \ (h - 5) \ (.5(h - 5))^{3/2}$$

$$Q_5 = 2.8 \ (754) \ (h - 5)^{3/2}$$

C = 2.8 for a broad-crested earth weir

$Q_7 = Q_4$

Q_8 unchanged

Since we are not going to deal with $h > 9$, this is sufficient.

The BASIC program which follows calculates a stage-discharge curve for Bog Brook Dam.

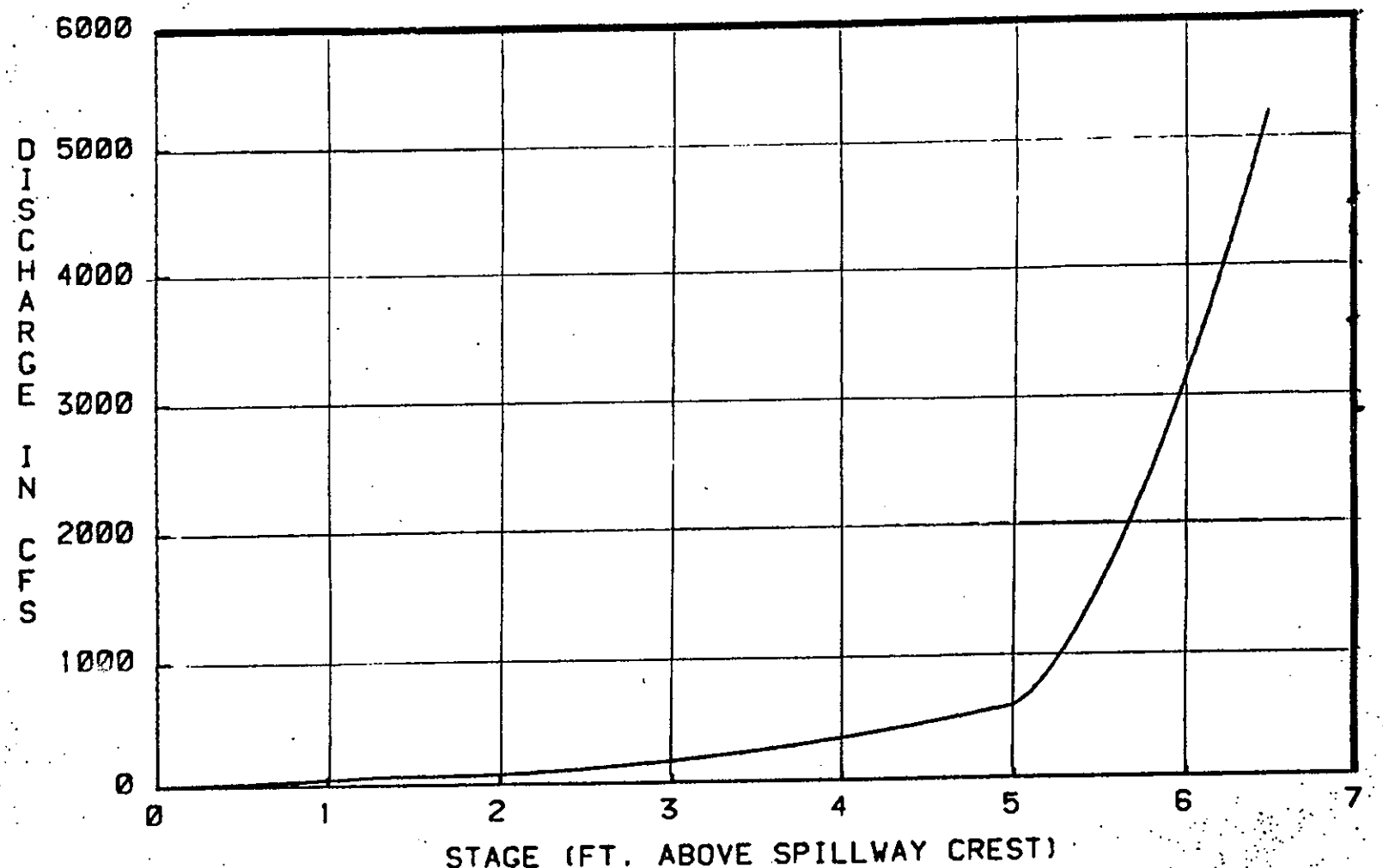
```
100 REM - STAGE/DISCHARGE CURVE FOR BOG BROOK DAM
110 REM - STORED ON TAPE B-1 FILE 10
120 PAGE
130 REM - THE D1 ARRAY CONTAINS EMERGENCY SPILLWAY Q VS. H DATA
140 REM - N1 IS THE # OF Q VS. H POINTS
150 N1=14
160 DIM D1(2,N1)
170 DATA 0,1.5,2,2.2,2.5,3,3.5,4,4.5,5,5.5,6,6.5,7
180 FOR I=1 TO N1
190 READ D1(1,I)
200 NEXT I
210 DATA 0,0,10,25.2,49.9,105,180,272,383,510,660,820,1010,1220
220 FOR I=1 TO N1
230 READ D1(2,I)
240 NEXT I
250 PRINT USING 260;
260 IMAGE 10T"STAGE VS. DISCHARGE RELATIONSHIP FOR BOG BROOK DAM  "
270 PRINT USING 280;
280 IMAGE // 6T"HEAD"                30T"DISCHARGE"
290 PRINT USING 300;
300 IMAGE 1T"(FT. ABOVE S/W)"32T"(CFS)"
310 PRINT USING 320;
320 IMAGE 19T "TOTAL    PRINCIPAL S/W    EMERGENCY S/W    TOP OF DAM"
330 PRINT "  "
340 PRINT " "
350 FOR H=0 TO 6.5 STEP 0.25
360 Q2=0
370 Q3=0
380 Q4=0
390 Q5=0
400 Q6=0
410 Q7=0
430 REM - Q2 IS THE FLOW WHICH CANN PASS OVER THE RISER CREST
440 Q2=3.3*12.57*H↑1.5
```

```
450 REM - O1 IS THE PRINCIPAL SPILLWAY OUTFLOW
460 O1=O2
470 REM - O3 IS THE FLOW WHICH CAN PASS THROUGH THE OUTLET PIPE
480 O3=16.5*(H+13)↑0.5
490 IF O2<O3 THEN 510
500 O1=O3
510 IF H<1.5 THEN 700
520 REM - THE EMERGENCY SPILLWAY FLOW (O6) IS DETERMINED BY LINEAR
530 REM -    INTERPOLATION OF THE VALUES IN ARRAY D1.
540 IF H<D1(1,N1) THEN 580
550 REM - LINEAR EXTRAPOLATION BEYOND D1 CURVE
560 O6=D1(2,N1)+(H-D1(1,N1))*(D1(2,N1)-D1(2,N1-1))/(D1(1,N1)-D1(1,N1-1))
570 GO TO 630
580 FOR I=1 TO N1
590 IF H=>D1(1,I) THEN 610
600 GO TO 620
610 NEXT I
620 O6=D1(2,I-1)+(D1(2,I)-D1(2,I-1))*(H-D1(1,I-1))/(D1(1,I)-D1(1,I-1))
630 IF H<=5 THEN 700
640 O4=2.8*50*(H-5)*(0.5*(H-5))↑1.5
650 O5=2.8*754*(H-5)↑1.5
660 O7=O4
700 T1=O1+O4+O5+O6+O7
710 T2=O4+O5+O7
720 PRINT USING 730;H,T1,O1,O6,T2
730 IMAGE 6D.2D,14D,13D,17D,14D
740 NEXT H
750 END
```

STAGE VS. DISCHARGE RELATIONSHIP FOR BOG BROOK DAM

HEAD (FT. ABOVE S/W)	DISCHARGE (CFS) TOTAL	PRINCIPAL S/W	EMERGENCY S/W	TOP OF DAM
0.00	0	0	0	0
0.25	5	5	0	0
0.50	15	15	0	0
0.75	27	27	0	0
1.00	41	41	0	0
1.25	58	58	0	0
1.50	63	63	0	0
1.75	68	63	5	0
2.00	74	64	10	0
2.25	94	64	29	0
2.50	115	65	50	0
2.75	143	65	77	0
3.00	171	66	105	0
3.25	209	67	143	0
3.50	247	67	180	0
3.75	294	68	226	0
4.00	340	68	272	0
4.25	396	69	328	0
4.50	452	69	383	0
4.75	516	70	447	0
5.00	580	70	510	0
5.25	922	70	585	267
5.50	1495	71	660	764
5.75	2231	71	740	1419
6.00	3102	72	820	2210
6.25	4111	72	915	3123
6.50	5234	73	1010	4151

STAGE-DISCHARGE CURVE FOR BOG BROOK DAM



Stage-Storage Curve

The storage at the spillway crest (h = 0, 1039 ft msl) is 40 ac-ft. The pond area at 1040 ft msl is about 16 acres. Assuming this surface area, and no spreading as the pond rises,

Surcharge storage = 16h

Total Storage = 40 + 16h

For the drainage area of 500 acres

$$1" \text{ of runoff} = \frac{500 \text{ acre } (1")}{12"/\text{ft.}} = 41.7 \text{ ac-ft.}$$

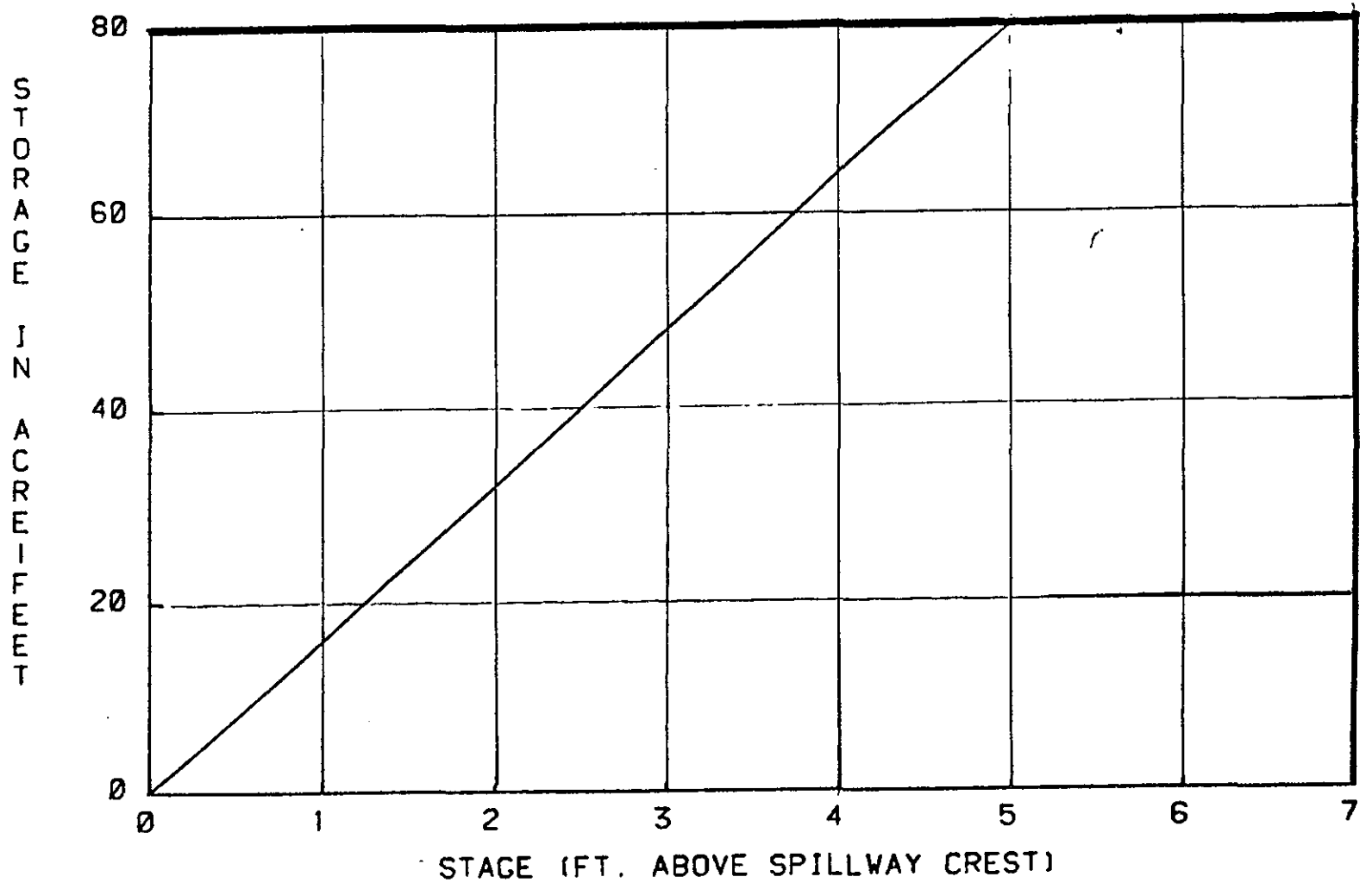
$$1 \text{ ac-ft.} = \frac{1}{41.7} = 0.24" \text{ of runoff}$$

Surcharge storage to the dam crest = 5(16) = 80 ac-ft. = 1.92" of runoff.

At the dam crest, total storage = 40 + 80 = 120 ac-ft.

The stage-storage curve is given on the next page.

STAGE-STORAGE CURVE FOR BOG BROOK DAM



BOG BROOK DAM

TCG
5/21/80

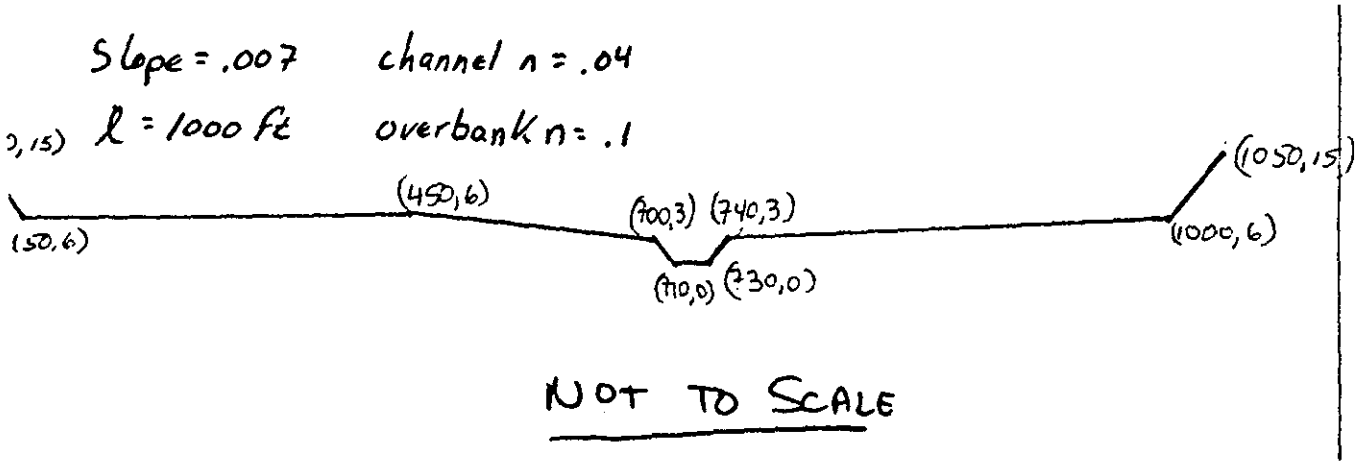
Dam Failure Analysis

Assume failure when the water overtops the dam crest at h = 5, 1044 ft msl.

Normal outflow = 580 cfs

Breach outflow = $Q_{pl} = 8/27\ W_b\sqrt{g}\ (Y_o)^{3/2}$

Y_o is the difference between the water surface elevation behind the dam at failure and the tailwater elevation. This depends on the cross section downstream of the dam, which is shown below (established from field notes):



NOT TO SCALE

A stage-normal flow relationship for this reach is given on the next page.

===== DATA FOR THE COMBINED SYSTEM =====

DEPTH ft.	ELEV ft.	AREA ft↑2	WPER ft.	HYD-R ft.	AR2/3	Q cfs
0.00	0.0	0.0	0.0	0.0	0.0	0.0
0.50	0.5	10.8	23.5	0.5	6.5	20.2
1.00	1.0	23.3	27.0	0.9	21.2	66.0
1.50	1.5	37.5	30.4	1.2	43.1	134.3
2.00	2.0	53.3	33.9	1.6	72.1	224.8
2.50	2.5	70.8	37.4	1.9	108.4	337.9
3.00	3.0	90.0	40.9	2.2	152.3	474.7
3.50	3.5	131.3	125.9	1.0	135.0	673.7
4.00	4.0	215.0	210.9	1.0	217.8	942.9
4.50	4.5	341.3	295.9	1.2	375.3	1309.0
5.00	5.0	510.0	380.9	1.3	619.5	1794.0
5.50	5.5	721.3	465.9	1.5	965.2	2417.7
6.00	6.0	975.0	550.9	1.8	1426.5	3198.2
6.50	6.5	1451.4	956.6	1.5	1916.5	4207.2
7.00	7.0	1930.6	962.2	2.0	3071.1	5816.5
7.50	7.5	2412.5	967.9	2.5	4435.1	7705.7
8.00	8.0	2897.2	973.5	3.0	5994.4	9854.0
8.50	8.5	3384.7	979.1	3.5	7738.3	12246.4
9.00	9.0	3875.0	984.8	3.9	9658.1	14871.2
9.50	9.5	4368.1	990.4	4.4	11747.2	17718.9
10.00	10.0	4863.9	996.1	4.9	13999.5	20781.9
10.50	10.5	5362.5	1001.7	5.4	16410.3	24053.5
11.00	11.0	5863.9	1007.4	5.8	18975.3	27528.1
11.50	11.5	6368.1	1013.0	6.3	21690.6	31200.7
12.00	12.0	6875.0	1018.7	6.7	24553.1	35067.0
12.50	12.5	7384.7	1024.3	7.2	27559.8	39123.1
13.00	13.0	7897.2	1029.9	7.7	30708.0	43365.5
13.50	13.5	8412.5	1035.6	8.1	33995.4	47791.1
14.00	14.0	8930.6	1041.2	8.6	37419.8	52397.1

BOG BROOK DAM

TCG
5/22/80

The pre-failure outflow of 580 cfs would yield a stage of 3.3 ft. downstream of the dam.

Y_o = height-tailwater = 18' - 3.3' = 14.7'

W_b = breach width = 40% of dam width at half-height =

.4(630) ≈ 250 ft.

$Qp = 8/27 \quad 250\sqrt{g} \ (14.7)^{3/2} = 23{,}700$ cfs

Total outflow = 23,700 + 580 ≈ 24,300 cfs

Storage at failure = 120 ac-ft.

Downstream of the dam Bog Brook runs about 1000 ft. before reaching the first developed area, which consists of 3 houses - a trailer about 7 ft. above the brook, a house 8 ft. above the brook, and a house 10 ft. up.

To calculate the attenuation in the brook downstream of the dam before dam failure flow reaches these houses, we will use two 500 ft. reaches. The cross-section given previously is typical of the entire 1000 ft., in which the brook is marshy, with standing pools and an extensive flood plain.

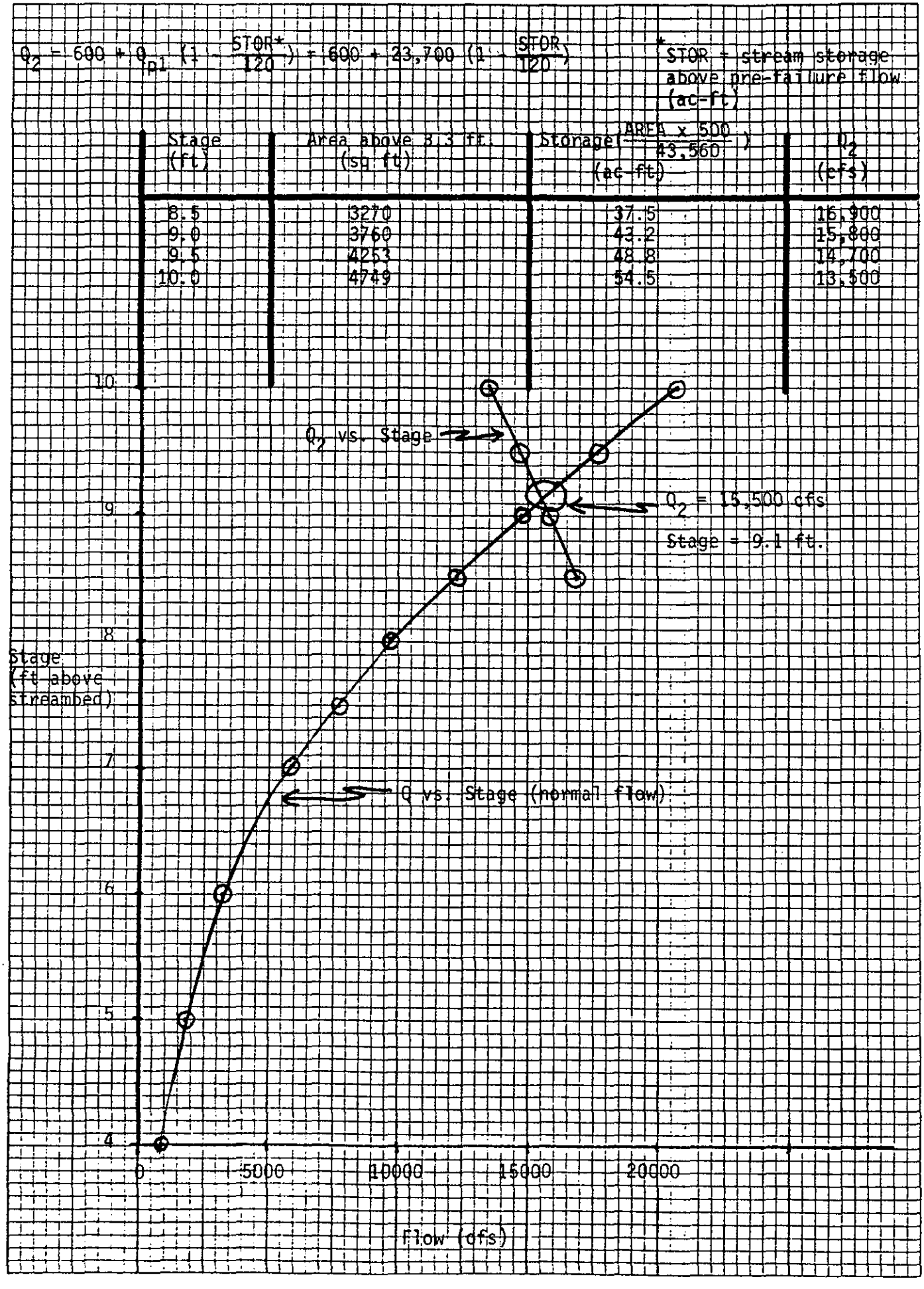
The attenuation of dam failure flow due to storage in the first 500 ft. reach downstream of the dam is calculated on p. D-15.

Attenuated Peak Dam Failure Flow 500 ft. Downstream of Dam TCG 5/21/80

$Q_2 = 600 + Q_{P1}\left(1 - \frac{STOR^*}{120}\right) = 600 + 23{,}700\left(1 - \frac{STOR}{120}\right)$

*STOR = stream storage above pre-failure flow (ac-ft)

Stage (ft)	Area above 8.3 ft. (sq ft)	Storage $\left(\frac{AREA \times 500}{43{,}560}\right)$ (ac-ft)	Q_2 (cfs)
8.5	3270	37.5	16,900
9.0	3760	43.2	15,800
9.5	4253	48.8	14,700
10.0	4749	54.5	13,500



BOG BROOK DAM

TCG
5/22/80

The attenuated peak failure flow 500 ft. downstream of the dam is 15,500 cfs, with a peak stage of 9.1 ft.

The attenuation in the next 500 ft. down to the houses described above is determined on p. D-17.

The peak failure flow from the dam at the three houses 11,100 cfs, which would result in a stage of 8.3 ft. This would cause 1-2 ft. of flooding at the trailer and slight flooding at one of the two houses. This would cause damage to the houses but would present only a small threat of loss of life.

About 1500 ft. downstream of the three houses there is a small dirt road crossing Bog Brook with 2-60" culverts. This embankment would probably be damaged or destroyed by dam failure flows.

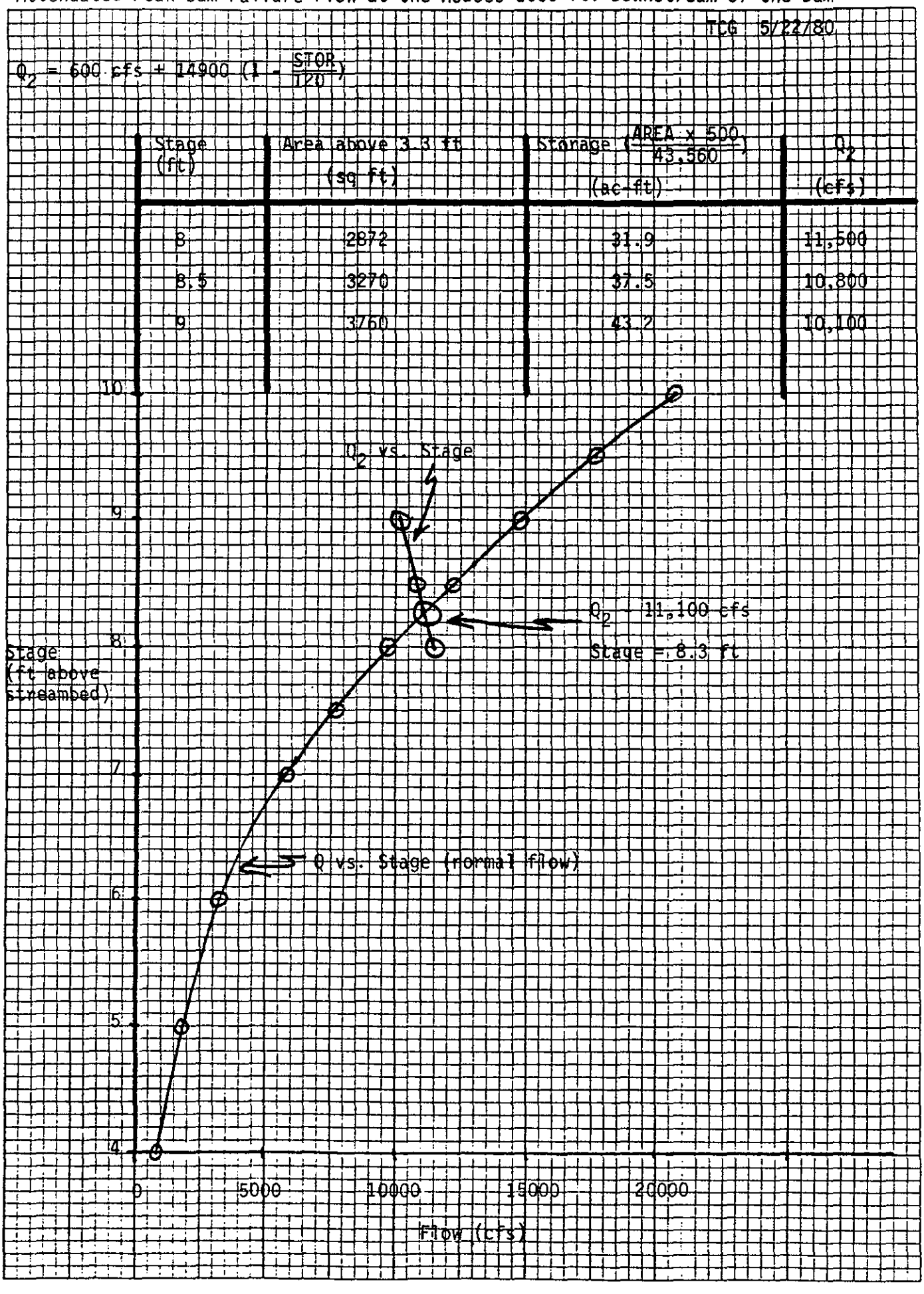
Downstream of this road, Bog Brook flows about 1000 ft. further to Stocker Pond. The large floodplain in this reach would continue rapid attenuation of the failure flood wave from Bog Brook Dam. Stocker Pond has a surface area of about 85 acres, so if the entire 120 ac-ft. released by the failure of Bog Brook Dam were to enter Stocker Pond with no outflow, the pond elevation would rise only $\frac{120 \text{ ac-ft.}}{85 \text{ ac.}} = 1.4$ ft. Thus, the dam failure flow would probably not cause damage to any property near Stocker Pond, and this large pond would further attenuate failure flows, rendering downstream effects negligible.

Attenuated Peak Dam Failure Flow at the Houses 1000 ft. Downstream of the Dam

TCG 5/22/80

$Q_2 = 600 \text{ cfs} + 14900 \left(1 - \frac{STOR}{120}\right)$

Stage (ft)	Area above 3.3 ft (sq ft)	Storage $\left(\frac{AREA \times 500}{43,560}\right)$ (ac-ft)	Q_2 (cfs)
8	2872	31.9	11,500
8.5	3270	37.5	10,800
9	3760	43.2	10,100



BOG BROOK DAM

TCG
5/22/80

The table on the next page summarizes the downstream effects of the failure of Bog Brook Dam.

Test Flood Analysis

Size classification: SMALL (storage between 50 and 1000 ac-ft; height less than 40 ft)

Hazard Classification: SIGNIFICANT based on the small chance of loss of life and significant economic damages at the three houses 1000 ft. downstream of the dam.

According to the Corps "Recommended Guidelines" the hazard classification and dam size indicate a test flood between the 100-year and 1/2 PMF. Since the hazard classification is on the low side of significant, we will use 100-year flood.

According to sheet 2 of the SCS "Summary of Hydrologic Data and Spillway Information," the 100-year peak inflow is 153 cfs.

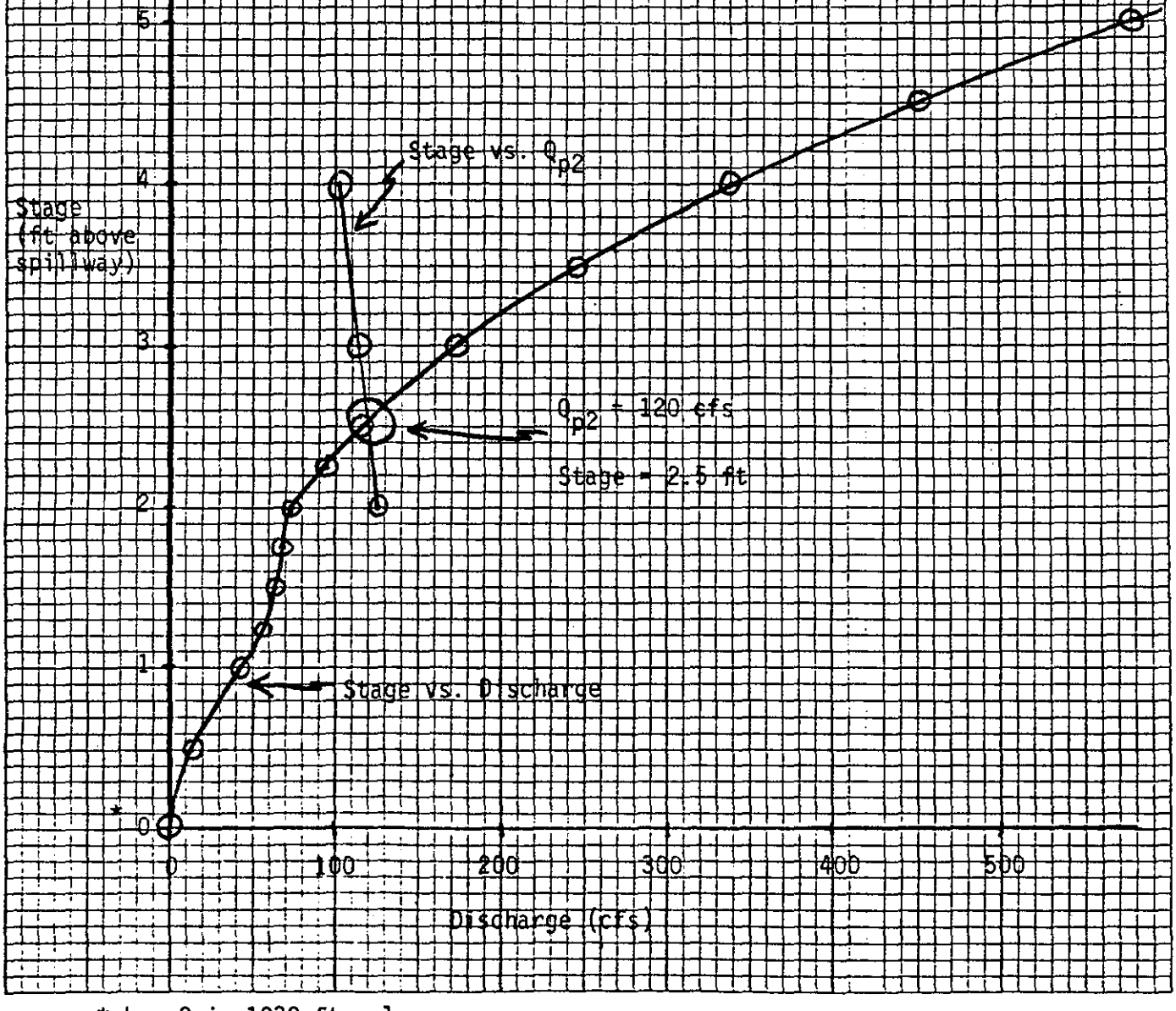
The attenuation of the test flood due to storage in the reservoir is calculated on p. D-20.

Location No. (see map)	Distance Downstream of Dam (ft)	# of Structures	Level Above Stream (ft)	Flow & Stage Before Failure	Flow & Stage After Failure	Comments
-	500	-		580 cfs 3.3 ft.	15,500 cfs 9.1 ft.	
1	1000	1 house 1 house 1 trailer	10	580 cfs 3.3 ft.	11,100 cfs 8.3 ft.	Some damage to house and trailer. Little danger of loss of life.
2	2500	road	~7	-	-	Probably washed out.
3 Stocker Pond	3500	-	-	-	-	1.4 ft. or less rise in pond elevation. Pond attenuates flow.

Attenuated Peak Test Flood Outflow at Bog Brook Dam TCG 5/22/80

$$Q_{p2} = Q_{p1}\left(1 - \frac{STOR}{4.5''}\right) = 153\left(1 - \frac{STOR}{4.5}\right)$$

Stage (ft above spillway)	Surcharge Storage (ac-ft)	STOR (Sur. Stor x .024) (inches of runoff)	Q_{p2} (cfs)
2	32	.77	127
3	48	1.15	114
4	64	1.54	101



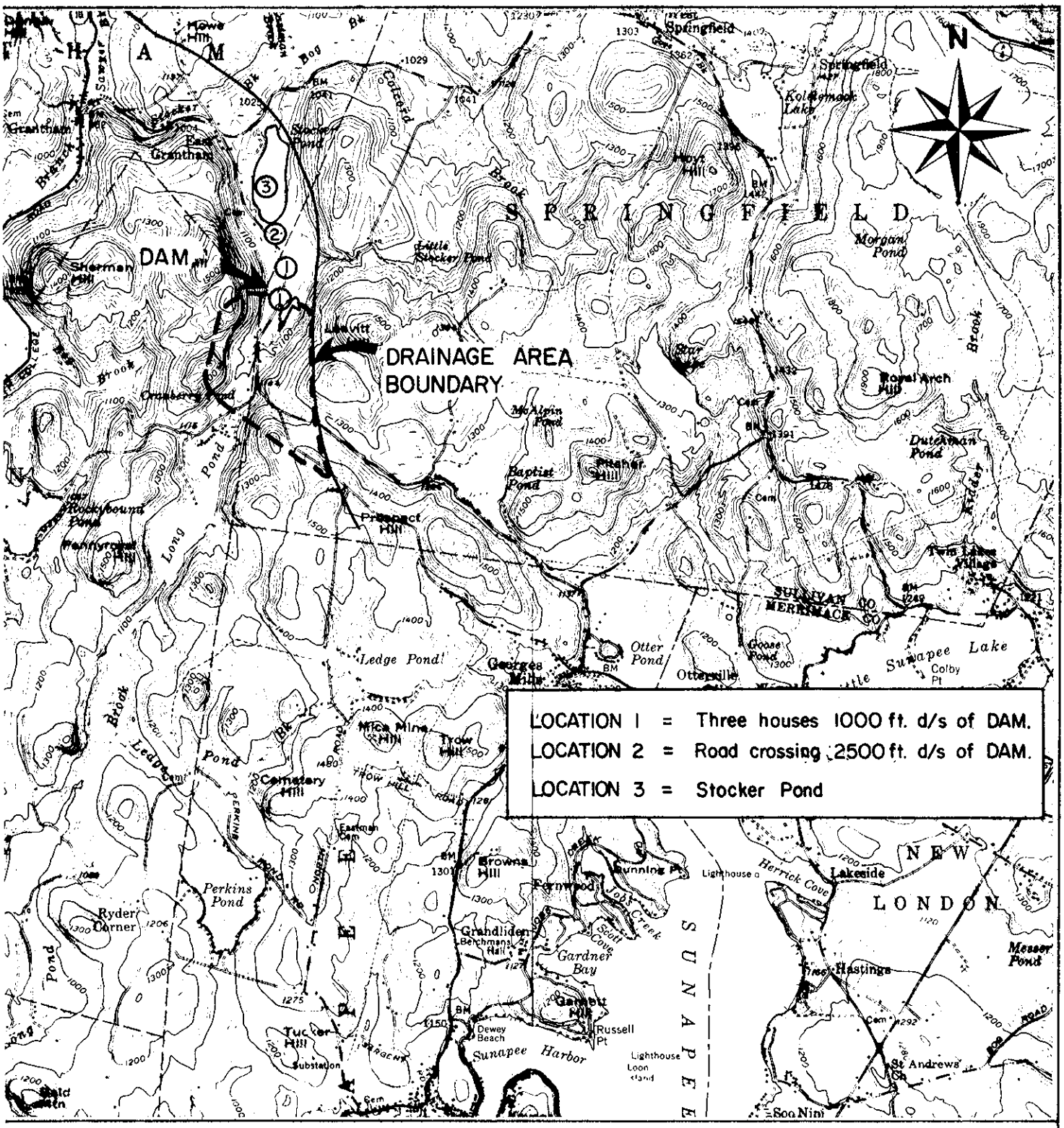
* h = 0 is 1039 ft msl

BOG BROOK DAM

TCG
5/22/80

The peak test flood outflow is 120 cfs, with a peak stage of 1041.5 ft msl, 2.5 ft above the spillway crest, 1.0 ft above the emergency spillway crest, and 2.5 ft below the dam crest.

The peak test flood outflow is $\frac{120}{580}$ = 20.7% of the spillway capacity with the water surface at the dam crest.



-SCALE-

0 1/2 1 2 (MILES)

FROM: USGS SUNAPEE - N.H. QUADRANGLE MAP

GOLDBERG · ZOINO & ASSOCIATES, INC.
GEOTECHNICAL - GEOHYDROLOGICAL CONSULTANTS
NEWTON UPPER FALLS, MASSACHUSETTS

U.S. ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LOCATION AND DOWNSTREAM HAZARD MAP

FILE No. 2605

BOG BROOK DAM NEW HAMPSHIRE

SCALE AS NOTED

DATE JUNE 1980

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

INVENTORY OF DAMS IN THE UNITED STATES

(1) STATE	(2) IDENTITY NUMBER	(3) DIVISION	(4) STATE	(5) COUNTY	(6) CONGR DIST.	(7) STATE	(8) COUNTY	(9) CONGR DIST.	(9) NAME	(10) LATITUDE (NORTH)	(11) LONGITUDE (WEST)	(12) REPORT DATE DAY	MO	YR
NH	10	NED	NH	013	02				HOG BROOK DAM	4325.2	7206.5	20	JUN	80

(13) POPULAR NAME	(14) NAME OF IMPOUNDMENT
	HOG BROOK RESERVOIR

(15) REGION	(16) BASIN	(17) RIVER OR STREAM	(18) NEAREST DOWNSTREAM CITY–TOWN–VILLAGE	(19) DIST FROM DAM (MI.)	(20) POPULATION
01	Hoo	HOG BROOK	WINFIELD	7	2345

(21) TYPE OF DAM	(22) YEAR COMPLETED	(23) PURPOSES	(24) STRUCTURAL HEIGHT (FT.)	(25) HYDRAULIC HEIGHT (FT.)	(26) IMPOUNDING CAPACITIES MAXIMUM (ACRE–FT.)	NORMAL (ACRE–FT.)
EARTH	1966	R	17	17	1200	400

DIST	OWN	FED R	PRV/FED	SCS A	VER/DATE
NED	N	N	N	T	

(28) REMARKS

(29) D/S HAS	(30) SPILLWAY CREST LENGTH	(31) TYPE	(32) WIDTH (FT.)	(33) MAXIMUM DISCHARGE (FT.)	(34) VOLUME OF DAM (CY)	(35) POWER CAPACITY INSTALLED (MW)	(36) PROPOSED (MW)	(37) NO	(38) LENGTH (FT.)	(39) WIDTH (FT.)	(40) LENGTH (FT.)	(41) WIDTH (FT.)	(42) LENGTH (FT.)	(43) WIDTH (FT.)	(44) LENGTH (FT.)	(45) WIDTH (FT.)
N	417		45	55												

(46) OWNER	(47) ENGINEERING BY	(48) CONSTRUCTION BY
THE PALAZZI CORPORATION	PALAZZI CORP + SCS	THE PALAZZI CORPORATION

(49) REGULATORY AGENCY			
DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
NH WATER RES BD	NH WATER RES BD	NH WATER RES BD	NH WATER RES BD

(53) INSPECTION BY	(54) INSPECTION DATE DAY | MO | YR	(55) AUTHORITY FOR INSPECTION
SPRINGER ZUPKO & ASSOC INC	30MAY80	PUBLIC LAW 92-367

(56) REMARKS
SEC. 6 0.8 SI SAMAC 32 CE 1000USGS SE 1000.5USGS